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THE

Journal of the Society of Arts,

AND OF

THE INSTITUTIONS IN UNION.

110TH SESSION.]

FRIDAY, APRIL 1, 1864.

[No. 593. VOL. XII.]

Announcements by the Council.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock.

APRIL 6.—“On the Principle of Imitation as Applied to the Decorative Arts.” By THOMAS PURDIE, Esq.

APRIL 13.—“On a New Process of Preserving Meat.” By Dr. MORGAN, Professor in the Royal College of Surgeons, Ireland.

CANTOR LECTURES.

The next lecture on “Chemistry applied to the Arts” will be delivered by Dr. F. CRACE CALVERT, F.R.S., F.C.S., corresponding member of the Royal Academy of Turin, of the Société Industrielle de Mulhouse, of the Société Impériale de Pharmacie de Paris, &c., on Thursday evening, at 8 o'clock, as follows:—

APRIL 7.—LECTURE II.—GELATINE, GLUE, BONE-SIZE CHONDRIE, their preparation, chemical properties, nutritive value, and application to arts and manufactures. Artificial tortoiseshell. *Isinglass*, its adulterations and adaptations to clarification of fluids. *Skins* and the art of tanning.

APRIL 14.—LECTURE III.—LEATHER.—The art of the currier. Morocco, Russia, and patent leathers. The art of tawing skins. Chamois and glove skins. Parchment. *Hair*, its composition and dyeing. *Wool*, its washing, scouring, bleaching, and dyeing. *Silk*, its adulterations and conditioning.

APRIL 21.—LECTURE IV.—ANIMAL FATTY MATTERS, the various processes for liberating them from the tissues in which they are contained. Their composition and conversion into soap. Composite candles. The refining of lard. *Cod-liver*, *sperm*, and other oils. *Spermaceti* and *wax*.

APRIL 28.—LECTURE V.—FLESH, its chief constituents, boiling, roasting, and preservation. *Animal black*, its manufacture and applications. The employment of animal refuse in the manufacture of *prussiate of potash*. *Prussian blue*. Manufacture of artificial animal manures.

MAY 5.—LECTURE VI.—ANIMAL LIQUIDS.—*Bile*, its purification and detergent properties. *Blood*, its application in the refining of sugar and the manufacture of albumen. *Albumen*, its use in calico printing and photography. *Urine*, its uses. *Milk*, its composition properties, falsification, and preservation. A few words on putrefaction.

Proceedings of the Society.

FIFTEENTH ORDINARY MEETING.

Wednesday, March 30th, 1864; Thomas Sopwith, Esq., F.R.S., Member of the Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Dircks, Henry, 16, Bucklersbury, E.C.
Gladstone, Thomas Murray, Lloyd's Proving Works, E.C.
Hodson, Francis, 6, Furnival's-inn, Holborn, E.C.
Keeling, E. Bassett, 4, Verulam-buildings, W.C.
Peterson, Charles, Newport, Isle of Wight.
Slade, Jeremiah, 102 and 103, St. John-street-road, E.C.
Turner, George, Northfleet, Kent.

AND AS HONORARY CORRESPONDING MEMBER,
Fowler, John Townshend, Madras.

The following candidates were balloted for and duly elected members of the Society:—

Barber, Thomas Archer, 2, Scott's-place, Lower-road, Islington.
Cheesewright, Charles, Alma-terrace, Highbury, N.
Hales, Edward, Dover.
Salt, Thomas Partridge, Ashton-villa, Moseley, Birmingham.
Slee, Edward, Church-street, Horselydown, S.E., and Clapham-park, S.

The SECRETARY called attention to new forms of barometer and thermometer, manufactured by Mr. Hicks, of Hatton-garden. Descriptions of these instruments are given at page 323.

The Paper read was—

ARTIFICIAL LIGHT AND LIGHTING MATERIALS.

By B. H. PAUL, Esq.

The use of artificial light being one of those appliances which belong to an advanced state of civilisation, it has naturally undergone that kind of progressive development which is characteristic of such arts. There has been, within the last 100 years, not only an immense improvement in the methods of obtaining artificial light, but also an equally important change in the sources whence lighting materials have been derived.

Towards the end of last century the only materials used for lighting were animal fats, such as tallow and fish oils, the former being used as candles, the latter burnt in lamps. Improvements were, from time to time, made in the preparation of these materials, by the introduction of new substances, and also in methods of using them; but those improvements, though highly advantageous, sink into insignificance when compared with the introduction of coal gas as a lighting material. In towns, the use of gas soon prevailed over the use of other lighting materials, but in the country, and especially in remote places, candles and lamps still continue to be largely used. The advantages of gas are indeed of such a nature as to require a thickly-populated town or district in order to be fully realised.

One of the materials formerly used for lighting, to a small extent and in a few localities, was petroleum; and some years before the introduction of gas, attempts were

made to prepare artificial petroleum from various bituminous minerals, in order to use it as a source of light. These attempts were progressing fairly, when the discovery that the inflammable gas obtainable from coal by heat, could be used for lighting purposes, was made known by Murdoch, and this new method of lighting became, for a time, almost the sole object of attention in regard to artificial light. The manufacture of artificial petroleum was, however, continued to some extent, in a few places, where circumstances were unfavourable for the introduction of gas lighting. About the year 1830 works were established in France for this purpose, and have continued in operation to this day. Somewhat later, other works were started in other parts of the continent as well as in this country; about the year 1853, the earth oil of Rangoon was examined by Mr. Warren De La Rue and Hugo Müller, with a view to its application for lighting purposes, and about the year 1860, the extraordinarily abundant supplies of petroleum in America became the object of special interest as materials for lighting.

CHEMICAL NATURE OF HYDRO-CARBON OILS USED FOR LIGHTING.

It is mainly to the products of natural and artificial materials, known under the various names of photogen, paraffin oil, &c., that I now beg to request your attention. Whether these materials be of natural or artificial origin, they all appear to agree in possessing the same general character, and in being of the same chemical nature. The chemical history of these materials is still very incomplete; but according to the results of the best chemical investigations, they appear to consist, for the most part, of mixtures of a considerable number of hydro-carbons, which differ from each other by small degrees in physical character and chemical composition, but at the same time present a general analogy among each other, and with the gaseous hydro-carbon known as marsh gas. This substance constitutes the initial and typical member of the series, while, at the other extremity of the series, are solid hydro-carbons, resembling wax or spermaceti in appearance, constituting a number of substances known to chemists under the collective name of paraffin. Between these two extremes there are a great number of other substances, solid, liquid, and gaseous, some of which have been separated and examined; others have not yet been obtained in an isolated state.

In addition to the hydro-carbons above enumerated, some others, belonging to other chemical series, have been detected, in smaller and varying proportions, both in the various kinds of natural petroleum, and in the tarry oils obtained by distilling bituminous minerals, peat, wood, &c., at a temperature not exceeding dull redness. These latter also contain a considerable proportion of oxygenated oils, which partake in general of the nature of creasote. In the natural petroleum the amount of these oxygenated oils is very much smaller, and it is only in some few instances that their presence has been recognised with any degree of certainty. Both in the natural petroleum and in the oils obtained by destructive distillation, there is always more or less of a kind of pitchy substance in solution, which gives to these liquids their characteristic black and tarry appearance, and there are likewise small quantities of strong-smelling substances, to which the peculiar and generally offensive smell of these materials is due.

ORIGIN OF NATURAL HYDRO-CARBON MATERIALS.

The very intimate chemical relation between native petroleum and the oily products of dry distillation, is highly interesting from the probability which it appears to suggest, that these materials, whether natural or artificial, have a common, or at least, a closely analogous origin. The close resemblance between petroleum and the oily products of dry distillation has long been recognised, and the actual identity of a great many of their several constituents which has been only recently ascer-

tained, is but a more detailed elucidation of the obvious analogy between these materials. Guided by this analogy, many naturalists have come to the conclusion that petroleum, in the various states in which it is met with, is the product of a kind of natural distillation that has taken place, or may be still going on, in the interior of the earth.

Whether or not this speculation be strictly correct, it undoubtedly presents a high degree of probability. All organic substances which are not themselves volatile, such as wood, flesh, and other vegetable and animal substances, yield, when subjected to the influence of heat below dull redness, tarry oils, which have in all cases the same general character and similarity to petroleum; differing only according to the specific differences in the materials from which they may have been obtained.

The various kinds of bituminous minerals met with chiefly in the coal measures, and to some extent in other geological situations, also yield, under similar conditions, oily products of the same general character. This fact at once becomes intelligible when it is remembered that the bituminous portion of the minerals from which such products are obtainable, has originated from the same kind of vegetable and animal substances that are now met with in nature. Hence, whether it be supposed that natural petroleum has been produced by an actual distillation of bituminous minerals, or by some other process, different, and slower in its operation, though effecting the same result as distillation, it is not the less evident that the ultimate sources of the minerals which serve for the manufacture of those lighting materials to which I am now referring, are in all cases the same—namely, organic substances, and those, in all probability, for the most part of vegetable origin.

There is, however, an important difference between these bituminous minerals and unaltered organic substances, in regard to their fitness for yielding by distillation such products as are suitable for the manufacture of hydro-carbon lighting materials. This is the difference that exists between the composition of unaltered organic substances and the composition of those remains of organic substances belonging to former epochs, which constitute the bituminous portion of the minerals to whose formation they have partly contributed.

Taking, for the sake of illustration, dry wood as representing the composition of the organic substances, which are the primary sources of bituminous minerals, and comparing it with the average composition of the bituminous portion of coal, it appears that for a given percentage of hydrogen the relative amounts of carbon and oxygen are widely different.

	Wood.	Coal.
Carbon	50.00	88.15
Hydrogen	5.55	5.26
Oxygen	44.45	6.59
	100.00	100.00

This difference arises from the alteration the organic substances have undergone during their passage into that bituminous portion of minerals by which they are now represented. This alteration consists in a progressive elimination of the oxygen, either as water or carbonic acid or both, and the consequent concentration of carbon, as may be seen from the following representation of this change:—

	Composi- tion of wood.	Composi- tion of water.	Residue.	Composi- tion of carbonic acid.	Residue.
Carbon ...	50.00	—	50.00	— 6	44.00
Hydrogen	5.55	1	4.55	—	4.55
Oxygen...	44.45	8	36.45	16	20.45
	100.00	9	91.00	22	69.00

This change is analogous to that which takes place in decaying organic substances, and is, in fact, a slow carbonization. Its effect is of considerable importance as regards the artificial production of hydro-carbons for lighting pur-

poses, inasmuch as the value of any material for this purpose increases with the increase in the amount of hydrogen, and the decrease in the amount of oxygen they contain. It is on account of the large amount of oxygen in wood and peat, as compared with coal, that those materials are less suitable for the manufacture either of illuminating gas or hydro-carbon oils. In the former case the gas produced from them contains such a large amount of carbonic acid, that its illuminating power is very slight, and in the latter case, the oils produced by distillation, are contaminated with oxygenated oils and resinous substances, which render their purification more troublesome than that of the oils obtainable from bituminous minerals, in which the amount of oxygen remaining is so much less.

But there is another feature in this alteration of the organic substances from which the bituminous portion of the minerals in question has originated. By referring to the above comparison between the composition of wood and that of coal, it will be seen that not only has the oxygen been, to a great extent, eliminated, but there has been an alteration in the ratio existing between the hydrogen and carbon. Instead of being, as in the case of wood, in the ratio of 1 hydrogen to 9 carbon, it is in coal in the ratio of 1 hydrogen to 17 carbon. This circumstance is indicative of the separation, during the change that has taken place in the conversion of decaying organic remains into the constituent bituminous minerals, of a compound of carbon and hydrogen, such, for instance, as marsh gas.

This gas, consisting of carbon and hydrogen in the ratio of 3 to 1, is always produced in putrefaction, and by the action of heat upon organic substances. It also occurs naturally in connection with the coal measures, constituting, together with small quantities of olefiant gas and nitrogen, the main portion of the fire damp of coal mines. Carbonic acid gas is also of frequent occurrence

in coal mines. These facts, together with the close chemical relationship between marsh gas and the various constituents of petroleum, all agree in adding to the probability of a very close connection between bituminous minerals and the various kinds of petroleum; a connection of such a nature, in all probability, that they should be regarded as of simultaneous origin, in the same way that the carburetted hydrogen or marsh gas of coal mines, has most likely originated, not from the decomposition of coal itself, but conjointly with coal, by the progressive alteration of the organic remains whence it and other bituminous minerals have been formed.

Exhalations of marsh gas almost always accompany the discharge of petroleum from natural springs, and in most of the American petroleum it is possible to recognise the presence of small portions of the other substances, ranging next to marsh gas in the above series, and gaseous under ordinary conditions of temperature and pressure.

CHARACTERS OF HYDRO-CARBON LAMP OILS.

In the absence of any important difference between those constituents of natural petroleum and of the oils obtained by distilling bituminous minerals, which are capable of being employed as lighting materials, it will be unnecessary to draw any special distinction between the oils manufactured for that purpose from different materials; and, in considering the characters which are requisite in these products, they need be contrasted only in regard to certain minor details, that are more consequences of the methods of manufacture practised, than of any more essential difference.

By examining the tabular statement of the composition and characters of the various substances constituting both petroleum and the so-called coal or shale oils, and considering what are the conditions under which the oils prepared from these materials are to be used for lighting

			Carbon.	Hydrogen.	Sp. Gr.	Carbon in one gallon.	Boiling point Fahr.	Vapour density.	Carbon in equal volumes of vapour.	Volume of air requisite for burning equal volumes of vapour.
						lbs.				
1	Methyl-hydride	$C_2 H_4$	(marsh gas).	75.00	25.00	—	gas	0.554	—	10
2	Ethyl-hydride	$C_4 H_6$	80.00	20.00	—	1	1.04	—	—	—
3	Propyl-hydride	$C_6 H_8$	81.81	18.19	—	—	1.52	—	—	—
4	Butyl-hydride	$C_8 H_{10}$	82.76	17.24	—	—	2.01	—	—	—
5	Amyl-hydride	$C_{10} H_{12}$	83.33	16.67	0.628	5.233	86	2.49	2.5	—
6	Hexyl-hydride	$C_{12} H_{14}$	83.72	16.28	0.669	—	158	2.97	3.0	—
7	Heptyl-hydride	$C_{14} H_{16}$	84.00	16.00	0.699	5.9	198	3.46	3.5	70
8	Octyl-hydride	$C_{16} H_{18}$	84.21	15.79	0.726	—	243	3.94	4.0	—
9	Nonyl-hydride	$C_{18} H_{20}$	—	—	0.747	—	278	—	4.5	—
10	"	$C_{20} H_{22}$	84.50	15.50	0.757	—	321	—	5.0	—
11	"	$C_{22} H_{24}$	84.61	15.39	0.766	—	359	—	5.5	—
12	"	$C_{24} H_{26}$	—	—	0.776	—	408	—	6.0	—
13	"	$C_{26} H_{28}$	84.78	15.22	0.792	—	423	—	6.5	—
14	"	$C_{28} H_{30}$	84.84	15.16	0.800	6.787	460	6.85	7.0	—
15	"	$C_{30} H_{32}$	—	—	—	—	496	—	7.5	—
16	Cetyl-hydride	$C_{32} H_{34}$	—	—	—	—	527	7.825	8.0	—
17	"	$C_{34} H_{36}$	85.00	15.00	0.825	7.022	...	8.37	8.5	—
18	"	$C_{36} H_{38}$	—	—	—	—	...	—	9.0	—
19	"	$C_{38} H_{40}$	—	—	—	—	...	—	9.5	—
20	"	$C_{40} H_{42}$	85.10	14.90	—	—	...	—	10.0	—
21	"	$C_{42} H_{44}$	—	—	—	—	...	—	10.5	—
25	Candle paraffin?	$C_{50} H_{52}$	85.23	14.77	0.870	7.41	Melting point. 130	12.19	12.5	—
27	Ceryl-hydride	$C_{54} H_{56}$	—	—	—	—	136	—	13.5	—
30	Myricyl-hydride	$C_{60} H_{62}$	85.31	14.69	0.890	—	143	14.61	15.0	—
	Olefiant gas	$C_4 H_4$	85.71	14.29	—	—	gas.	0.97	1.0	15

purposes, it will be evident that there is only a portion either of the natural or artificial material that is applicable as oil for burning in lamps.

Leaving out of consideration the first four members of the series, which are gaseous at ordinary temperatures, it will be seen that the remaining members of the series, which are liquid at ordinary temperatures, gradually increase in specific gravity, varying in this respect to the extent of $6\frac{1}{2}$ pounds per gallon to about $8\frac{3}{4}$ pounds per gallon. Beyond this latter point the other members of the series are solids, and come under the general denomination of paraffin.

Another important point of difference consists in the boiling point of the individual members of the series. This varies from 37° F. to upwards of 600° F. It is to this character that attention requires to be chiefly directed in regard to the degree of safety with which these substances can be used for burning in lamps. I say the *degree* of safety, because I am far from being disposed to agree with the opinion that has been put forward that the use of any of these substances is necessarily attended with danger. On the contrary, I am strongly inclined to think that all or any of them may be used without any necessary risk being incurred. Of course, due precautions must be observed in the use of these substances, and those precautions must be greater than are requisite in the case of the oils that were formerly used as lighting materials, viz., the fat oils obtained from animals, fish, and plants. Hydro-carbon oils are, by their nature, much more combustible than fat oils, at the same time that they possess higher illuminating power, and it would be by no means prudent to deal with the one in the same manner as with the other.

The outcry that has been raised against the dangerous character of hydro-carbon oils is, however, in no degree more deserving of respect than that which was raised on the same visionary ground when the use of gas was first introduced. All that is really necessary to avoid accident with the hydro-carbon oils is, that those who use them should be properly instructed as to the way in which they should be stored and used. By this means it will be far more likely that the desired result of preventing accident may be secured, than by exciting a vague and unreasonable apprehension of danger.

In regard to the safety of hydro-carbon oil used for burning in lamps, the main consideration is its capability of giving off vapour spontaneously at the ordinary temperature, or when the oil becomes slightly warmed. In regard to this character the various liquid members of the substances given in the table differ considerably. Taking the first of those that are liquid at the ordinary temperature, it will be seen that its boiling point, which is the thermometric indication of its degree of volatility, is 86° Fahr., a temperature so little above that which may exist in a room where lamps are used, that it would be very objectionable to use such a liquid as a lighting material in that way. The temperatures given in the table as the boiling points of the individual oils are not by any means the lowest temperatures at which they evolve vapour, and for this reason, if we fix 80° or 90° Fahr. as the highest temperature to which the oil in a lamp is capable of being raised, even in an extreme case, the boiling point of a liquid that would be suitable for burning in lamps, under such conditions, ought not to be less than 200° Fahr. above that temperature.

With the lamps now generally in use for burning hydro-carbon oils, it would be only under very exceptional and improbable circumstances that the oil in the lamp could become heated to a temperature so high as 80 deg. Fahr., and even then some of the more volatile portions of these oils, boiling at about 160 deg. Fahr., might be burnt without any danger.

But the hydro-carbon lamp oils are never distinct substances in a chemical sense, like the several substances whose characters are described in the above table. They are always mere mixtures of a number of those substances,

and consequently they do not present any constant point of ebullition, while the specific gravity and other characters are the mean of those appertaining to the several substances present in the mixture, and that mean also varies according to the relative proportions of the mixed substances.

The absolute separation of these substances is, indeed, a matter almost of impossibility, and, so far as relates to their practical application, not by any means requisite. It is, however, essential that in preparing hydro-carbon oil for use in lamps, the manufacture should be conducted in such a manner as to secure the separation of the more volatile portions, to such an extent, that the oil, when finished, may be heated to 100° Fahr. without taking fire when the flame of a match is brought into contact with its surface, in an open vessel such as a saucer. Oil that will bear this test is, I believe, perfectly safe for all reasonable use; and I am of opinion that this simple test is by far the best criterion of the proper character of such oils. While, of the oils constituting petroleum and coal oil, those which have a boiling point below 280° Fahr. would be too volatile for ordinary use in lamps, on the other hand, those which have a boiling point above 600 deg. Fahr. are also unfit for this purpose, but for very different reasons. It has commonly been supposed that the reason why these latter oils do not burn well in the ordinary lamps is, that they are too thick, and have not sufficient capillarity to rise in the wick and feed the flame. I am disposed to think that this view is erroneous, and am more inclined to the opinion that their defects, as lamp-oils, are to be ascribed rather to the high temperature requisite for their volatilization, and also to the greater density of their vapour. The chief difficulty that is experienced in the use of these oils of high boiling point, which are generally known as heavy oils, is the charring of the lamp wicks, and the small flame they give.

By reference to the table it will be seen that the oil which has a boiling point of 527° F., affords a vapour that is twice as dense as that of the oil boiling at 243° F., or, in other words, a given weight of the former oil occupies in the state of vapour only half the bulk of an equal weight of the latter also in a state of vapour. This circumstance alone will, to a great extent, account for the smaller flame of the heavier oils as compared with that of the more volatile oils, whose vapours are less dense. Then, in proportion as the volatility of the oils decreases, or as the temperature requisite for their volatilization increases, at the same time a greater degree of heat is necessary to effect that decomposition of the vapour into gas, which is an essential step in their combustion for lighting purposes. The temperature necessary to effect these changes is so high, that at the same time the wick itself gradually becomes charred and incapable of exercising that capillary action by which the flame can be fed with oil. In addition to these circumstances, it must also be remembered that in proportion as the density of the oil vapour increases, so does the amount of carbon in the vapour increase, and, at the same time, there is a proportionate increase, both in the heating power and the illuminating power of equal volumes of the vapour. Consequently, in using heavy oil of high boiling point in a lamp, the result is that a very small, intensely hot and highly luminous flame is produced at first, and after a very short time the wick becomes charred and incrustated with the surplus carbon, separated in the flame, to such an extent that it soon begins to decrease in size and to lose brilliancy.

It appears, therefore, that the oils at either extremity of the series are equally unfit for use in the ordinary hydro-carbon oil lamps. But in practice it never happens that any one of the several substances described in the table is used for lighting purposes. It is always a mixture of a number of them that is used. Still, the facts that I have just pointed out in regard to the extreme cases, exercise their influence in the same manner with regard to this mixture. On the one hand, it must not contain any such amount of the more volatile members of the

series, as will confer upon the mixture the property of giving off inflammable vapour when heated to 100° F., or enable it to become permanently inflamed when brought in contact with a lighted match while at that temperature. On the other hand this mixture must not contain such a proportion of the heavier and less volatile oils, as would render the vapour forming the flame too dense and too highly carbonaceous, and necessitate too high a temperature for that decomposition of the vapour which is essential to the production of light.

The due proportion of these various conditions is secured in practice by collecting the oils during distillation in fractional portions: that which distils over first containing the oils that are too volatile for use in lamps; the second portion that distils over being the burning oil, and the third portion containing the heavy oils and paraffin.

The precise points at which this separation of the oil into these three portions, takes place, will depend very much upon the nature of the material operated upon. In this respect there are great differences in the various materials now used as sources of these lighting oils. American petroleum generally requires the separation of some 20 or 25 per cent. of its bulk, which is too volatile for use in lamps. Canadian petroleum does not require more than 10 per cent. to be separated on this account. Coal and shale oils also vary much in this respect, according to the material they are produced from, and the temperature at which the crude oil is distilled from the coal or shale. As a general rule, the crude oil of coal or shale contains a greater amount of the volatile oils, the lower the temperature those materials are distilled at. This, however, is not a disadvantage, since the amount of crude oil obtainable is greater, the lower the temperature of the distillation. Generally speaking, coal or shale oil does not require that more than 5 to 15 per cent. of the bulk should be separated as too volatile to be mixed with the burning oil.

At the other extreme there are also differences between petroleum and coal or shale oils. The burning oils manufactured from the latter sources, as generally met with, have a specific gravity of about 0·825, while the specific gravity of those made from petroleum is rarely above 0·800, and sometimes as low as 0·780.

I do not believe there is any really sufficient reason why there should be this difference in the case of petroleum, which, as I shall afterwards point out, involves a serious disadvantage as regards its illuminating power compared with that of coal oil. The manufacture of these commodities, however, is still carried on so much more by mere rule of thumb, than under the guidance of sound principles based upon knowledge of the materials dealt with, that defects of this kind cannot be wondered at, and it will probably be some long time before these processes come to be carried on in such a way as to secure the best results both to the producer and the consumer.

ILLUMINATING POWER.

In the case of all kinds of lighting materials, the light produced when they are burnt, is due to their containing, or yielding when heated, olefiant gas, or other hydro-carbon gases, which are equivalent to it as regards the production of light. In the production of artificial light by any of the means that have been hitherto commonly used, it is always the result of the intense ignition of solid particles of carbon. Luminiferous hydro-carbon gases and vapours, which, for convenience sake, may be collectively represented by the term olefiant gas, all agree in the character of being decomposed at a temperature higher than that requisite for their production. In such a manner that the greater part of the carbon they contain, is set free in a state of very minute division. This is an essential character of these luminiferous substances. In any ordinary luminous flame the particles of carbon so separated become intensely heated, and emit light while being burnt, giving to the flame its whiteness and brilliancy.

The production of heat is, therefore, an essential preliminary to the production of light, and it is also equally

necessary for the production of light that the heat produced should act upon some solid substance. The separation of minutely-divided carbon from the luminiferous hydrocarbons, when they are heated, provides this essential condition for the production of light. Gases or vapours which do not yield any solid substance when burnt, do not afford a luminous flame, or at most, only a feeble light. Thus, for instance, hydrogen and marsh gas, or sulphur, burn without evolving any considerable light. Olefiant gas, on the contrary, burns with an intensely white luminous flame. At the same time it is indispensable that the solid particles separated in an ordinary flame should not retain their solid state, but should, by combustion, be converted into gas. The carbon separated in the flame of ordinary lighting materials, burns and is converted into carbonic acid gas. If this were not the case every flame would constantly produce a shower of dust.

The greater the number of solid heated particles in a flame, the greater will be the light it evolves, consequently, the amount of light capable of being produced by various hydro-carbon gases and vapours, or their illuminating power, is directly proportionate to the amount of carbon contained in a given volume of the gas or vapour, and capable of being separated during combustion. Taking olefiant gas as the standard of comparison, and referring to the table of the several hydro-carbon oils constituting petroleum and coal oil, it will be seen that the individual members of the series differ very considerably in this particular, and the figures expressing the relative amount of carbon also express the relative illuminating power of equal volumes of their vapours.

It is probable that in burning the vapour of any one of these substances the general nature of the decomposition which takes place consists in the production of marsh gas which burns, and the separation of all the carbon over and above that requisite for the formation of marsh gas. Consequently, in the flame of the substance, No. 4 of the table, there would be nearly twice as much carbon separated as in the flame of olefiant gas. Separation of carbon to such an extent would be more than sufficient for the production of light under ordinary circumstances, and would be accompanied by a tendency to the production of smoke, in consequence of some of the carbon escaping combustion. This tendency would of course be greater in proportion to the increased amount of carbon in the vapour, and although the illuminating capability would be greater in the same proportion, it would not be possible to realise that capability except under special conditions.

There is, therefore, a practical limit, in regard to the mode in which lighting materials are generally used, beyond which an increase in the amount of carbon in the material would be rather prejudicial than otherwise.

In the case of gas, it is never anything like an approximation to pure olefiant gas that is used, but only a mixture of it with other gases, containing from 5 to upwards of 20 per cent. of olefiant gas. The following gives the composition of coal gas in various localities:—

	Manchester. Roscoe.	Greenock. T. Thomson.			Newcastle. T. Richardson.		Bagdad. Lytle.
Olefiant gas.....	8·84	14·50	17·50	20·00	10·19	9·25	27
Marsh gas	34·90	66·49	59·94	47·77	31·35	36·05	...
Hydrogen.....	45·58	12·29	11·46	17·32	28·80	30·17	...
Carbonic oxide ..	6·64	7·07	12	11·76	16·28	11·42	...
Carbonic acid ...	3·67	...	...	...	...	...	...
Nitrogen	2·46	...	...	...	...	...	...
Sulph. hydrogen..	0·29	...	...	...	...	...	...

Of these gases, the first three after olefiant gas, are the only ones that take any part in the production of light, the others being mere impurities. Those gases, however, do not contribute directly to the production of light to any extent, but being themselves combustible, serve in part, to produce heat requisite for decomposing the olefiant

gas, and rendering the particles of carbon separated from it luminous. They also serve to prevent the flame from smoking, by diluting the olefant gas, and thus admitting of its being brought more intimately in contact with the air required for perfect combustion. They also give bulk to the flame, and thus diminish the concentration of the light which would take place if the olefant gas were burnt without any admixture.

In all these respects each one of the three gases answers the purpose required of it equally well or nearly so. There are, however, other particulars in regard to which there is a very considerable difference in their fitness for these purposes. This difference consists in the respective capability of these gases for producing heat and carbonic acid by their combustion. Any amount of heat produced by burning any lighting material, over and above that requisite for giving the necessary temperature to the flame, is obviously objectionable, since it would have the effect of heating the atmosphere of the space lighted and rendering it oppressive. Since all lighting materials contain carbon, and by their combustion abstract oxygen from the air, the production of carbonic acid is, to some extent, a necessary result of the use of any such material; but, on account of the prejudicial influence of this gas, it is highly desirable that the quantity produced, for a given quantity of light, should be as small as possible. In both these respects there is a very wide difference between the effects of the three gases which are generally contained in coal gas as the dilutants of the olefant gas. This will be seen from the following table:—

	Heating power for equal volumes.	Relative volume of Oxygen consumed.	Volume of Carbonic acid produced.	Temperature of Flame.
		Air.		Fahr.
Hydrogen	4299	0.5 = 2.5	0	4966°
Carbonic oxide	3234	0.5 = 2.5	1	5619°
Marsh gas	14,634	2.0 = 10.0	1	4940°
Olefant gas ...	...	3 = 15	2	...

This comparison serves to show that although hydrogen produces more heat by combustion, and gives a lower temperature in the flame, than carbonic oxide, still it is the best substance to be used for diluting the olefant gas, since it affords no carbonic acid. On the contrary, marsh gas is worse even than carbonic oxide, on account of its producing much more heat and carbonic acid. In regard to the amount of carbonic acid generated, and the heating effect produced for a given quantity of light, gas, however, has a great advantage over any of the lighting materials formerly used. As compared with tallow, for instance, gas produces only one half or less than half as much carbonic acid, and little more than one-third the heating effect. But it would be a very great improvement in the manufacture of gas if it could be produced with hydrogen alone as the diluting substance. Many years ago an attempt was made to effect this by Selligie in Paris, and subsequently the same thing was tried in this country by Professor Donovan and Mr. White, under the name of water gas; but both projects proved unsuccessful, owing to a variety of adverse circumstances.

It will be evident from what has already been said with regard to the dependance of the luminosity of a flame upon its temperature, that it is desirable to produce the highest attainable temperature in the flame, and that any means of increasing that temperature would have the effect of increasing the illuminating effect. A very elegant contrivance for this purpose, in the case of gas, has been devised by Dr. Frankland. It consists in heating the air consumed in the combustion of the gas, by means of the waste heat radiated from the flame, by making it pass down along the side of the chimney before entering at the bottom of the burner to supply the flame. In this way

the air is heated to 500° or 600° F., and there is, of course, a corresponding increase of temperature in the flame. Dr. Frankland has ascertained that by this simple appliance the same amount of light may be obtained with a saving of 49 per cent. of gas, and that for a given consumption of gas there is an increase in the illuminating effect to the extent of 67 per cent.

Returning now to the liquid hydro-carbon oils used for lamps, I will endeavour to point out how the principles I have described in reference to gas, obtain in the application of those oils to lighting purposes. In this case the hydro carbon vapour is not mixed with any diluting substance, as in gas, and all of these oils would give off a considerable amount of smoke if burnt in the same way as fat oils, by reason of the highly carbonaceous nature of their vapours. This circumstance was one of the most serious impediments to the introduction of these oils in the first instance, but eventually a lamp was devised which satisfied all requirements, and which is now largely in use. To understand the way in which the combustion of hydro-carbon oils in these lamps is effected without production of smoke, it must be remembered that in ordinary cases the flame of any lighting material, being for the most part gaseous and in contact with atmospheric air, there is, in accordance with the well-known laws of gaseous diffusion, a continual intermixture of air with the gaseous substances in the flame, and the extent to which this intermixture takes place is determined by several conditions, which may be regulated at pleasure. To take the simplest case, that of gas; the rate of intermixture will be proportionate with the rate at which the gas issues from the burner, and to the velocity of the current of air passing along the sides of the flame. When gas is burnt with a large argand gas burner it is very liable to smoke, but when a glass cylinder is placed over the flame, the gas burns without smoke, in consequence of the greater intermixture of air with the flame, caused by the draught of the chimney. The degree of draught, and consequently of intermixture of air with the burning gas will depend upon the height of the chimney. With a very high chimney and powerful draught the intermixture may be effected to such an extent as to neutralize, almost entirely, the illuminating power of the flame. In order, therefore, to effect perfect combustion without loss of lighting effect, it is necessary to proportion these determining conditions of the intermixture of air with the flame, according to the nature of the material to be burnt.

It is in this manner that the combustion of the hydro-carbon oil in lamps is effected. By means of the chimney a strong current of air is produced, and by means of the perforated cone, immediately over the wick, that current of air is made to impinge upon the ascending vapour, and mix with it so as to enable it to burn without smoke. In this case, therefore, the air, by means of which combustion is supported, is made to serve the purpose of the diluting gases in ordinary coal gas, giving greater bulk to the gaseous contents of the flame, and effecting such a distribution of the ignited particles of carbon, as to admit of their being perfectly burnt.

The necessity of this admixture of air with the vapour of hydro-carbon oil to enable it to burn without smoke, is of course greater in proportion as that vapour is denser and more highly carbonaceous. In this respect it will be seen that the several members of the series of substances constituting these oils differ materially. For instance, the vapour density of No. 16 is twice as great as that of No. 4, and there is the same difference between the amounts of carbon in the vapours. The former vapour would also have double the illuminating power of the latter; but the size of the flame of No. 16 would be proportionately smaller, and owing to these two circumstances, the ignited particles of carbon would be so crowded together that a great deal of smoke would be produced unless a copious intermixture of air was effected by means of a very vigorous draught.

Practically the differences between the several substances here referred to, compensate each other in consequence of their being mixed together, in the various kinds of hydro-carbon oils. Thus the higher illuminating power of the denser vapours is to a great extent rendered available by the more bulky nature of the less carbonaceous vapours, and in this way a mean result is arrived at, of both characters combined, which answers all desired purposes. Everything depends upon the due proportionate mixture of the different substances.

From these considerations it will be seen that there is a positive disadvantage in carrying the separation of the more volatile portions of the oil beyond such a point as is indispensably requisite for its being used with safety; for the more those substances are separated from the oil intended to be used in lamps, so much the more must the least volatile portions, at the opposite extremity, be separated from it, in order to obtain a material fit to burn without smoke, and with a sufficiently large flame.

It will now be necessary to consider briefly the applicability for lighting purposes of the hydro-carbon oils which are too volatile to be used in the ordinary lamps. It is a fact that will be familiar to many of the members of this Society, that the idea of applying such highly volatile hydro-carbons as lighting materials is not, by any means, a thing of yesterday. It was first conceived, I believe, long before the year 1830, by a gentleman who has occupied, and still occupies, a most prominent position among those who have contributed to the successful establishment of gas lighting. Mr. Lowe's original proposal was to use the volatile hydro-carbons obtained from the tar of gas works in the place of water in gas meters, so as to serve the double purpose of measuring the gas supplied to consumers, and of augmenting its illuminating power. Next to him came Professor Donovan, who proposed to make water-gas the medium for vaporizing these liquid hydro-carbons; and he appears to have formed this idea independently of any knowledge of Mr. Lowe's plan of naphthalizing gas. However that may be, the originality of the project in point of time certainly belongs to Mr. Lowe. These projects attracted very great attention at the time; but they never came into anything like general application. It may be that on reflection, the gas companies did not esteem very highly a plan for doubling the illuminating power of their gas, since that advantage was not necessarily accompanied by a demand for twice as much light as was previously used.

Some years afterwards another attempt was made to employ these highly-volatile hydro-carbons as lighting materials, by the late Mr. Mansfield, to whom we are indebted for a very excellent investigation of the chemistry of gas tar. His plan was to use atmospheric air as the medium for volatilising the hydro-carbons, chiefly with the view of applying them in this manner for the lighting of country-houses or other places remote from gas works. The material that he employed for this purpose was the more volatile portion of gas tar, now known to chemists under the name of benzol; it possessed a character, however, which proved fatal to the undertaking—it was that of becoming solid when considerably cooled. In consequence of this the reduction of temperature produced by its own volatilization rendered it solid, and stopped its further evaporation.

Strangely enough, this very same plan of using atmospheric air saturated with the vapour of a volatile hydro-carbon has quite recently been put forward with much pretence, as a totally new invention, notwithstanding the fact that Mansfield's patent entirely covers this application of these substances, and that as this patent has expired, the process is now public property.

The naphthalizing of coal gas, though still older, has also been brought before the public lately, under a new name, as being a new invention.

It now only remains to consider how far it may be practicable to use the highly volatile hydro-carbons of

petroleum and similar materials for lighting purposes, by diffusing their vapour through atmospheric air. These liquids are free from that prejudicial character of solidifying when cooled, which renders benzol obtained from gas tar, inapplicable for the same purpose. They are now obtained in tolerable abundance in connection with the manufacture of hydro-carbon lamp oils, and they are to a great extent still mere waste products, since they do not answer well as a substitute for turpentine, which is the chief use they have yet been put to. It is, therefore, possible that these liquids might be obtained in sufficient quantity and at such cost as would admit of their being used as lighting materials.

By a reference to the table it will be seen that, as compared with olefant gas, their illuminating power is considerable. Taking the substance No. 7 as representing the available volatile portion of petroleum, its vapour has $3\frac{1}{2}$ times the illuminating power of olefant gas; in other words, gas containing $3\frac{1}{2}$ per cent. by measure of this vapour would have the same illuminating power as coal gas containing about 12 per cent. of olefant gas, and with 7 per cent. of this vapour it would be equal to the best cannel gas.

There is one important point, however, in regard to this application of the volatile hydro-carbons which cannot be overlooked, and which requires to be thoroughly examined before any attempt is made to use them in this way. It is well known that hydro-carbon gases, such as olefant gas, or marsh gas, the representative of all these hydro-carbons, when mixed with air in certain proportions, form a mixture that is violently explosive. It, therefore, becomes a question of very serious moment whether this fact presents any real or insurmountable obstacle to the use of atmospheric air as the medium for using these volatile oils in the condition of gas. Whether, in fact, under the conditions to be observed for such a use of these oils it would be possible to get a mixture of the vapour and of air that would be explosive when brought in contact with a flame. If that be possible, even in some extreme case, that may be of unlikely occurrence, then there can be no doubt that the use of these oils in that way would be highly objectionable.

It cannot be doubted, looking at the mere possibility of the matter, that with these vapours, just as with marsh gas, an explosive mixture might be produced. There is no question as to that. The question really to be considered is, whether such a result could take place under the conditions for using these oils.

It is well known that the explosibility of a mixture of marsh gas and air, depends upon the relative proportion of the gas and air. For its perfect combustion marsh gas requires 10 times its volume of air. Such a mixture is explosive when brought in contact with flame, and the explosive character still continues when the proportion of air is not more than six or seven times as great as the marsh gas. But when marsh gas is mixed with only three or four times its volume of air, the mixture is not at all explosive, but will burn like the unmixed gas. In the same manner, other hydro-carbon gases require to be mixed with a certain proportion of air to form explosive mixtures; and with regard to the vapours of the volatile hydro-carbons, this is equally the case. In consequence of the density of these vapours being so much greater than that of their representative—marsh gas—they require much larger proportions of air for their combustion. Thus, for instance, the vapour of the oil No. 7 requires 70 times its volume of air for combustion. In all probability such a mixture would be explosive. But a mixture of this vapour with air which would possess an illuminating power equal to cannel gas, would not contain more than 27 parts of air to one of the vapour. Such a mixture, I believe, would not be explosive under any circumstances that require to be taken into account.

Then as regards the possibility of an explosive mixture being formed, it appears to me highly probable that the extreme volatility of these liquids would in itself constitute

a most effectual safeguard against the formation of an explosive mixture. To ensure the efficacy of this character of the oils, however, it would be indispensable that arrangements should be made for securing the intimate contact of the air with the hydro-carbon to be volatilised, and likewise the constant maintenance of a fresh supply of hydro-carbon. All these points, however, are mere matters of detail, which would acquire importance only after the determination of the fact that, with a sufficiently volatile oil, its vapour mixed with air might be burnt like gas without any danger of an explosive mixture being formed. If that were satisfactorily proved to be the case, it is likely that this mode of using those portions of hydro-carbon oils that are still without any satisfactory application, might be introduced with advantage in many cases. Among others I may mention the lighting of railway carriages, and of houses or public institutions situated at a distance from gas works.

DISCUSSION.

Dr. MARCET, F.R.S., understood Mr. Paul as directing attention to the heating action produced by various lighting agents. This property, no doubt, varied very much in the different agents used—some gave out more heat than others, and some evolved more carbonic acid gas than others. Coal gas produced less carbonic acid than petroleum and other substances of that kind. This subject was important in connection with the effect of artificial light upon health. No doubt in rooms where lights were burnt for a considerable time, unless proper regard were paid to ventilation, a large amount of noxious gases were evolved. These gases consisted of carbonic acid, sulphurous acid, and others of a more or less pernicious nature. In some cases in rooms where lights were burnt in which the combustion was not complete, there was a formation of carbonic oxide which was most poisonous. When explosions took place in mines not only carbonic acid was formed, but also carbonic oxide, and these were both destructive of life in a very short time, but each separately had a different action in the destruction of life. Carbonic acid gas destroyed life comparatively slowly, while carbonic oxide immediately struck down any one who breathed it. In the case of the lamentable explosion at the Hartley colliery, which was attended with so large a loss of life, he had no doubt that a mixture of carbonic acid and carbonic oxide was formed, and he hoped, for the sake of the victims themselves, that the latter predominated, inasmuch as their sufferings would be less protracted than under the influence of carbonic acid alone. The action of these gases produced such different appearances after death that it could be ascertained by which of them the death had been caused. Carbonic acid gas rendered the blood left in the veins of a dark colour, while in cases of death from carbonic oxide the red colour of the blood was heightened. The fact of these gases being generated by the combustion of the agents used for lighting purposes made it necessary that the utmost attention should be paid to ventilation. He thought the plan of lighting adapted in the room in which they were assembled was so perfect that it was impossible there could be any accumulation of noxious gases, while the light itself, by being concentrated into one large focus, was of a very efficient character, and ventilation was greatly promoted. The subject of lighting by petroleum having been alluded to by Mr. Paul, he could have wished that some further information had been given with regard to the Rangoon petroleum. From that material had been manufactured a very perfect lighting agent under the title of Belmontine, but he was afraid the supply of that petroleum, as indeed of many other kinds, was considerably on the decrease, but he had no doubt that other sources of supply would be obtained as the original ones failed.

Dr. BACHHOFFNER said on a recent occasion when they were favoured with a paper on an analogous subject to this, he expressed a somewhat strong opinion with reference to the use of hydro carbons as lighting agents, which

opinion he saw no reason to retract. He still maintained that for the ordinary oils of commerce a sufficient guarantee should be given as to their non-inflammability at a temperature below a certain fixed standard; otherwise there was danger in their use for domestic purposes. He did not dispute the correctness of Mr. Paul's statement that, if these oils were used under proper precautions, they would be safe enough: but the great difficulty was to ensure those precautions in ordinary households. Most of the lamps at present in use required to be trimmed and lighted in a peculiar way, and with great care, and this could hardly be trusted to servants. He had no objection to offer against the use of these lighting agents, provided a satisfactory guarantee were given by the retailers of the article that it would not explode at a temperature below 100° at least, though he would rather have a margin of 20° or 30° degrees above that. There was at present a certain amount of danger in the use of these hydro-carbon oils. He was aware that the same objections were raised against ordinary gas on its first introduction. He had no doubt they could easily blow up a house with gas if they were so disposed, but this would only result in most cases from great carelessness. The peculiar odour of gas was a great safeguard in its use, for any escape was at once detected. He remembered there was once an attempt made to deprive coal gas of its odour, but he regarded that as the greatest security they could have against accidents, for if they allowed the taps to be turned on they were apprised of the fact through the medium of the olfactory sense. With regard to petroleum, until there was a satisfactory guarantee when hydro-carbon oils were purchased, that they were not explosive at a temperature below something like 130°, he considered they were not safe for general domestic use.

Mr. ROBINSON, as one who had had some experience in the use of paraffin oil, fully confirmed the views expressed by the last speaker, as to the necessity for a sufficient guarantee being given as to the temperature at which these oils would inflame. Without that guarantee he considered their use objectionable and dangerous. The system under which they were at present sold was extremely unsatisfactory. A short time since he purchased some paraffin oil which was guaranteed not to ignite upon the application of a match to it in a saucer; but upon testing it he found it ignited very readily. He thought it worthy the consideration of this Society how far petroleum oils might be employed for the purpose of heating steam boilers, instead of as a lighting agent. He thought the use of paraffin and petroleum oils highly dangerous with the present tall lamps, which were liable to be upset by the smallest accident, when the most serious consequences might ensue. He fully concurred in the views of Dr. Bachhoffner as to the desirability of a more satisfactory guarantee being given of the degree of inflammability of these oils.

Dr. BACHHOFFNER said petroleum had been used in America to a great extent for generating steam in steam-boilers, and a report had been issued showing that it had been attended with certain advantages.*

Mr. WANKLYN thought too much importance was attached to the comparison of lighting materials as regarded the relative qualities of carbonic acid produced in combustion. Ordinary air contained from three to five parts of carbonic acid gas in 10,000 parts of air. Experiments made upon air taken from the most crowded theatres of London showed it to contain not more than fifty parts of carbonic acid in 10,000. If they considered the immense quantity of air there was in a room, and made a simple calculation, it would appear that no description of lighting material they could have could produce an amount of carbonic acid that was likely to have a serious effect upon health. He believed it had never been established that the difference between 5 parts and 50 parts in 10,000 had an injurious effect upon the

* See page 324, "Use of Petroleum in Steamers."

health; and the probability was that the injurious effects of close air were due to something else, rather than to the slight additional quantity of carbonic acid gas. He believed the amount of carbonic acid present under such circumstances was practically of no moment whatever. With regard to the danger of explosion, petroleum had only recently come into use, and he believed one of the most effectual ways of guarding against this was to use lamps holding only a small portion of oil. To cause an explosion they required air to be mixed with the vapour of petroleum, and it was only when this vapour was present in a large proportion that explosion was possible. When the lamp was full of oil there could be no explosion; the accidents occurred for the most part when the lamp was nearly empty.

MR. TEGETMEIER said, having investigated the circumstances of a great many accidents alleged to have been occasioned by the explosion of paraffin lamps, he had only met with one genuine instance, which occurred at Bethnal Green in the autumn of last year. In that case the lamp was a cheap and badly constructed one; the oil used was inflammable at 110° (disposing of the alleged safety of oil at 100°), and a woman in attempting to put the light out blew down the chimney, which ignited the oil, and the burning liquid was scattered over her, occasioning a considerable amount of injury. With regard to the inflaming point of oil he understood Mr. Paul to put the point of safety at 100° . He (Mr. Tegetmeier) thought the inflaming point should be placed some degrees higher. He had never traced an accident to oil inflaming at over 120° ; therefore he agreed with Dr. Bachhoffner that they ought to have a guarantee of safety up to about 130° . As to danger in the use of really good oil, he believed it was practically *nil*; and with oil uninflamable up to about 130° ; they might use the lamp in the roughest manner, and even spill the oil, without the slightest danger.

MR. PAUL, in reply upon the discussion, said with reference to the remarks of Dr. Marcet, as to the relative amount of carbonic acid given out by different lighting materials, it was only necessary to say that as the illuminating power of these materials entirely depended upon the amount of carbon they contained, it followed that for a given quantity of light they must yield a given quantity of carbonic acid. In the table given in the paper the various materials mentioned were seen to contain carbon in slightly different proportions, the greatest amount being contained in olefant gas, which was about 86 per cent., while marsh gas contained about 75 per cent., and the latter had no illuminating power, while the former produced a brilliant light. It was a mistake to suppose that petroleum had an advantage over coal gas in producing less heat: for the production of heat as well as of light depended upon the amount of carbon; the more light, the more heat and the more carbonic acid they had. The only room for improvement in the case of gas, as far as he could see, was with regard to the diluting agents of olefant gas; these were of three kinds—carbonic oxide, carburetted hydrogen, and hydrogen. These differed in the amount of heat they produced, and carbonic oxide was objectionable from its poisonous properties. The improvement would be to substitute hydrogen for marsh gas or carbonic oxide: still he repeated, for a given quantity of light they must have a given quantity of carbonic acid and a given quantity of heat. The production of carbonic oxide under the circumstances in which gas, petroleum or candles were burned, seemed to him to be beyond the range of possibility. Carbonic oxide could only be produced by the combustion of carbonaceous substances where there was a deficiency of oxygen. When a light was burnt with insufficient air the consequence was smoke, which preceded the production of carbonic oxide, and gave sufficient warning of the risk. There was a method of lighting which had been tried, which he had no doubt would eventually be successful, and would be largely used, in which the light was obtained without any carbonic acid

being produced. He referred to the lime light, in which the solid substance, instead of being carbon, was a piece of lime, intensely heated by the flame of oxygen and hydrogen. The possibility of using that plan of lighting for ordinary purposes rested upon one circumstance, viz., the production of cheap oxygen. If this could be cheaply supplied there would be no further difficulty about the lime light: but under present circumstances the improvement that could be made in the existing methods of lighting consisted in better modes of ventilation, such as were adopted in this room—a principle first introduced by Faraday, and one which might be regarded as perfect in all respects. With regard to the Rangoon petroleum, the history of it was very simple. It was an extremely good material for the manufacture of hydro-carbon oils, the best of the kind being that known as the Belmontine, of Price's Candle Coy., but the cost of Rangoon petroleum in this country was from £20 to £25 per ton, while the American was supplied at from £12 to £18. It did not therefore require many words to say why Rangoon petroleum was not used. With regard to American petroleum he was far from enthusiastic about the future of that. He was disposed to think the oil distilled from coal and other similar minerals would become the staple material for the production of these illuminating oils. With regard to the alleged danger attending the use of these materials, he must say he could not agree with the apprehensions entertained by gentlemen whose opinions, however, were deserving of great respect. The idea of being limited in the use of these materials by the stupidity of domestics was a thing he did not like to submit to. The probability of a gas tap being left with the gas escaping was quite as great as that of any blunder through which an accident might be produced by the use of petroleum. Of course in the use of all these materials a reasonable and proper amount of care must be exercised, and, as with ordinary gas, they must have proper apparatus for burning these oils, which apparatus must be carefully managed. The fact that these oils could afford light in country places, where gas was not obtainable, at a price of little more than half as much again as gas, was sufficient to prove that they were a considerable boon to the great mass of the people. There was another fact which was not sufficiently attended to—that was the enormous aggregate consumption of these oils. There were several factories which turned out 30,000 gallons of oil per week, and the number of accidents they heard of was infinitely small when compared with the extent to which these materials were used. At the same time it was quite proper that it should be settled by competent authority what should be the standard of safety in these oils. The Act of Parliament, passed some time ago, unfortunately only applied to the storing of petroleum and other inflammable substances, and left out of consideration other important points. The Act merely provided that not more than 40 gallons of oil, lighting at a temperature below 100° , should be stored within a certain distance of a dwelling house; but less than 40 gallons of such oil, if ignited, might occasion very serious damage. With regard to the temperature of ignition, if it were possible to use oil that would light at 100° with perfect safety, provided they used proper lamps in a proper way, it was desirable that no impediment should be placed in the way of doing so; at all events, the question should be settled, and the absolute degree of safety established. With regard to the use of these materials for fuel, that admitted of very simple comment. He was aware they had been tried in America, but a slight consideration of the composition of petroleum would show that this was not likely to answer commercially. The heating power of petroleum was not more than $1\frac{1}{2}$ times that of coal, and while the price of petroleum in this country was about £18 per ton, coal was about £1 per ton. From this fact alone they might judge how far the application of petroleum to heating purposes in manufactures was practicable.

Mr. SYMONS said that the assertion of Mr. Paul—that heat bears a constant proportion to light, did not agree with the experiments of Dr. Frankland. According to the published tables of those experiments, the heat produced did not bear any constant proportion to the amount of light evolved.

The CHAIRMAN thought they could not but feel obliged to Mr. Paul for the interesting paper he had brought before them this evening, and also for the further observations he had been kind enough to make on matters arising out of the discussion. The subject of lighting was a very interesting and important one, both as regarded the lighting of towns and the interior of dwellings. Those who had been in any of the towns of the East, which were entirely unlighted at night, except by the small lanterns people carried about with them, would not be surprised at the fact, that when the Turkish Ambassador came to London, he thought the city was illuminated in honour of his arrival, though the only lights used at that period were oil lamps. He might mention, that long after the introduction of gas into Newcastle-upon-Tyne, he saw a house there blown up by gas. The singular fact connected with this occurrence was, that in that house no gas was laid on; but the pipe for the public lighting having burst, the gas found its way into the house, and the servant, going about with a lighted candle, produced the explosion, which was attended with very serious consequences. That accident, at the time, was very likely to lead to a supposition that gas would prove a very dangerous thing, and that accidents of that kind would be of frequent occurrence. Yet it was the only instance of the kind he ever heard of, and 40 years had passed over without the repetition of such an occurrence, showing how erroneous a view might be entertained as to the question of danger. Reference had been made to the application of these oils to heating purposes. That was a subject well worthy of most careful consideration, because everything that tended to economise coal must tend to the duration of this country as a great and powerful nation. The Chairman concluded by moving a vote of thanks to Mr. Paul.

The vote of thanks having been passed,

Mr. PAUL, in reply to what had fallen from Mr. Symons, said he thought Dr. Frankland would be the last person to dissent from the view he had put forward as to the amount of light, and consequently of heat produced, being in direct proportion to the amount of carbon contained in the vapour burnt. As to the reason why the oxy-hydrogen blow pipe did not give light in proportion to the heat, it was simply from the fact that the gases burnt contained no carbon, and yielded no solid product.

Proceedings of Institutions.

ASHTON AND DUKINFIELD MECHANICS' INSTITUTION.—The report for last year congratulates the members upon the prosperity of the Institution. The number of members is now larger than at any previous period in its history, although it is far below what it ought to be. There is ample accommodation for double the present number of members. The list of honorary members, although larger than at any previous period, is not commensurate with the wealth or intelligence of the town. During the past year two lectures have been delivered in the Institution, in both instances free of charge. The committee suggest the desirability of inaugurating a course of lectures with occasional meetings of a more social and entertaining character. The chess and draught rooms are well attended. During the past year a Discussion Society has been formed, and has proved a decided success. Papers upon various interesting subjects have been read and discussed. The meetings of the society are held in the winter months, and it num-

bers fifty-five members. A "Field Naturalists' Society" was projected rather late in the season, but several very interesting excursions were taken in the immediate neighbourhood, and the natural history of the district investigated. Combining both pleasure and profit—the study of natural history amidst natural scenery—this society has many points of attraction. To ladies it offers, in conjunction with the library, opportunities for mental culture and recreation which no other department of the Institution possesses. The number of member is 520, being an increase of twenty-nine on the former year, seventeen of whom are factory operatives. The partial improvement which has taken place in the staple industry of this district since the last annual meeting has resulted in an increase in the class of factory operatives of 33 per cent. The classes now in operation are, writing, arithmetic, grammar, geography, and mathematics, meeting four evenings in the week; French, meeting once a week; mechanics, architecture, and free-hand drawing, meeting once a week. In the library, the present number of volumes is 3,470, being an increase during the year of 130. The total number of issues was 7,225.

GREVILLE HOUSE WORKING MEN'S LIBRARY AND READING ROOM, PADDINGTON.—The seventh annual report says that there is a circulating library of nearly 1,300 volumes, an increase of 100 over last year. The number of members on the books at present is about 230 (about the same as last year), of whom about 10 pay extra, and avail themselves of the classes, or some of them. The number of books taken out of the library during the year was about 3,500. The last twelvemonth has witnessed a great movement for the promotion of clubs for working men. Mr. Gladstone, in a recent speech in Flintshire, had said, much on the advantages of institutions of this kind. Greville House has for several years exhibited a practical example of the working man's library and reading room, in conjunction with educational classes. As the "Club" feature of such institutions is just now attracting attention, it may be mentioned that coffee is to be had on the premises, and that a smoking-room is provided. The continuous steady work of the classes, the examinations for prizes, and the other educational machinery, prove, that the means of moral and mental improvement are afforded, while the agreeable scenes presented by the soirées of the members, and the pleasure afforded by an occasional lecture or other entertainment of an avowedly amusing character, show that innocent recreation is not forgotten. Last year's report contained the usual notice that prizes had been offered for the study of works of useful information, and it was mentioned that the subjects then proposed were, "Lessons on Morals," and "The Science of Health." As on former occasions a smaller number of competitors came forward than could have been desired, but those who did so acquitted themselves well. The prizes were awarded as follows:—"Morals," W. Peters, 1st prize, G. Anderson, 2nd prize; "Science of Health," Mr. Burch, 1st prize, Mr. Carrier, 2nd prize. These prizes were distributed at a public meeting, when Lord Ebury took the chair. The subjects for examination for 1864 are Blunt's "Sketch of the Reformation in England," and "The British Settlements in India," a work published by the Society for Promoting Christian Knowledge. During the past year the Institution has been brought into union with the Metropolitan Association for Promoting the Education of Adults. The Bible class goes on steadily. During the last summer some disappointment was felt from the utter failure of every attempt to obtain a cricket-ground. It is much to be regretted that in the present state of London it is next to impossible for the working-man to share in recreations of this kind. During the summer evenings the Greville House band performed every Saturday evening on Paddington-green. During the autumn months a gymnastic class has been held in the large room of the Institution. Lectures have, as heretofore, been regularly given every week, during spring and winter, and the committee express their great

obligations to the friends who have kindly come forward to take part in the course. The annual soirée of the members took place, and was most successful.

THE ART-WORKMANSHIP PRIZES.

The following is from a correspondent:—

In considering the second series of prizes which is now offered by the Society of Arts for the best, and the second best, specimens of "Art-Workmanship," it is important to recollect that the purpose of the Society is not, in the first and largest division of the series, to call for what is commonly styled "design," even in its humblest form of adapting existing materials, but for workmanship *per se*. An appeal is made to those numerous classes of skilled artisans whose crafts are exercised in the debateable land that lies between art and labour. The Society acts on the conviction, which has long been entertained by those acquainted with the subject, that our skilled workmen rarely have opportunities for studying, in the practical manner which a competition involves, those admirable examples of successful production in their respective crafts which the past has stored up for us. It is desirable to put models of perfect workmanship before men whose powers are frequently limited in scope, and whose knowledge is too often technical, or, to speak strictly, merely practical in its nature. By doing this the technical ability of every competitor is worthily tested, and even those who are unsuccessful in the trial must profit by a noble kind of practice.

These are the general and direct objects of the Society. The system by which it is attempted to carry out those objects has several points which we would commend to workmen:—1. The prizes are liberal in amount, ranging from £3 to £20; the scale in each class being carefully adapted to the nature of the work required, the cost of production, &c. 2. Competitors may execute their tasks after working hours, so that they need not interfere with current duties of the workshop. To this end ample time is given for production, and that time which is most convenient for the tasks, *i.e.*, the season of long days has been designated. Works are not to be sent in to the Secretary of the Society of Arts till the 26th November next. 3. The works produced are to remain the craftsman's own, whether premiated or not; and the only condition attached to the competition by the Society, with regard to possession of the same, is advantageous to competitors. This is, that all specimens shall be retained a reasonable time for exhibition. This exhibition will probably take place at the South Kensington Museum, or else in the House of the Society of Arts. 4. Models, either in the form of casts or of photographs, are obtainable at the mere cost of production. 5. All the models selected by the committee of the Society appointed to deal with this matter are such as admit of the works produced from them being brought into use so as to have a commercial value of their own in each instance, independent of that attaching to the character of examples which have been honourably distinguished. With a view to enable competitors to dispose of their works the Society calls upon the makers to state the price at which they may be sold, or, should they be sold before they are sent in competition, that at which a copy may be had. It is needless to point out to workmen or employers the advantages attending success in competitions such as these. In point of fact the Society of Arts undertakes all the expense and trouble of getting up an exhibition of competing works, rewards the skilful, and makes their names known over the length and breadth of the land.

The second division of the series of prizes is for works executed without prescribed designs, and embraces in its subjects the human figure, animals, foliage, fruit, grotesques, etc. The first prize in this division is the Society's silver medal and £25. Of course its subjects involve "design" as well as execution. The Society, with great consideration for the peculiar circumstances of those whom it invites to com-

pete for its prizes, has instituted a second set of prizes, of the same amount in each class, for female competitors only, although all classes are open to them. The additional set of prizes comprises painting on porcelain, decorative painting, and the production of wall mosaics.

From the list of examples set forth by the Society I propose to select such as appear to admit of special remarks upon their character, their history, and those points in their execution which deserve particular consideration.

It is difficult to conceive a finer example of execution, or one better fitted for application to modern uses, than the beautiful group of a boy and dolphin, which is offered as the theme for the first prize in Class 1, carving in marble, stone, or wood. Such a work may be employed as a bracket, as a console, or cantilever; it might be placed over a fireplace, under a balcony, or in any other similar situation. The subject is one of those spirited themes so often adopted with perfect success by the great Italian sculptors, who gave their attention to the production of decorative works. A winged boy is placed astride of a dolphin, and guides it by reins held in the right hand, while with the left he grasps a flag and waves it behind him. An appearance as of rapid motion is imparted with admirable skill, by the flying hair of the child, by the full-blown character of the banner, and, principally, by the plunging attitude of the dolphin; note also the clinging of the thin drapery that clothes the part of the boy's body as an exquisite example of drapery employed so as to become expressive in itself. Every part of the execution of this work is worthy of careful study. Even the subordinate parts of the scroll which form the console itself are designed with perfect taste. See the bold, yet graceful, curve given to the mouldings, the fine treatment of the line of decorations on its front, composed of a modification of the "egg and tongue" ornament, showing scallops and tongues placed alternately. No carver who loves his work will omit to deal carefully with the beautiful "rosettes" of open lotus-flowers which, on the sides of the model, form the eyes of the scrolls. Competitors who use the full sized cast of this sculpture which the Society supplies will have a decided advantage in dealing with it. Good as the photograph is, much of the detail is out of its range. The dolphin, the filmy fins and almost animated tail of which are remarkable for design and treatment, deserves special attention. In the latest edition of the inventory of the South Kensington Museum the original of this work is numbered 5; its "Register," or permanent number, is 5,896. It is ascribed to Donatello (?), the sculptor of the famous "David" and "St. George," a Florentine, born 1383, died 1466. Competitors who may resolve to work from the photograph only, and not to avail themselves of casts from the actual object, are earnestly recommended to examine the casts, which will be deposited at the house of the Society of Arts, Adelphi, London, at the South Kensington Museum—where also the original is readily accessible—and at the Schools of Art in Edinburgh, Dublin, Manchester, Glasgow, Birmingham, and Hanley in the Potteries. This recommendation applies to all the other works, copies of which may be seen at the above-named places.

The second example to which I shall call attention is that proposed as the model for the prize offered in class 1 for ornamental work. In this case, as in the last, copies will have to be produced in marble, stone, or wood. The model is a carved chair-back, dating from about the end of the fifteenth century, copies of which may, however, be adapted to uses other than that of the original, *e.g.*, the work, if reproduced in wood, might be applied as a panel on the door of a wardrobe, or other similar office admitting of flat decoration. Some parts of the example have, as far as regards art-value, much greater interest than others. The head of a terminal-winged figure is surrounded by festoons, from behind the pedestal of the figure issue some beautiful scrolls of natural foliage, beneath is a cartouche, having in its centre a lion's head. The treatment of the body of the

terminal figure is highly objectionable, not to say bad, in art; the head of the same has not much to recommend it, the festoons, of which there are several subordinate repetitions, are good, but rather commonplace. The cartouche, notwithstanding that it offers, in the bold and yet precise characters of its elements, many opportunities for the display of skill in carving, cannot be quoted as valuable in its designs; few cartouches of this date have any pretension to be ranked as works of art. The admirable part of the composition, and that which will try the skill of competitors, is the foliage, of very simple and elegant character, which issues from behind the pedestal, and spreads itself over the flat ground of the object in exquisite spiral forms. Here, indeed, is a model worthy of study, and of the most thoughtful imitation. The round and firm, yet, so to say, fleshy branches, which hold the leaves and their berries, can hardly receive too much attention. The skillful union of the stems with their adjuncts, the modelling of the crisp leaves and of the dexterously-placed berries is delightful. That valuable element of ornamental work, the grotesque, is here represented by the lion's head, and is a most unfortunate example, its sole merit being that of flatness, which is estimable in a work of this class, and sustains the style of the whole.

The second example offered for reproduction in the section of ornament (class 1), although a much less elaborate one than that last named, is wholly satisfactory. It is a fine bracket, or corbel, made to receive a vaulting-shaft, an example of "stiff leaf foliage" of transitional character, approaching to the style of the Decorated phase of Gothic art. It suggests nearly all the beautiful design and execution of the similar works in Wells Cathedral (south transept). Although it is suggested by the committee that "the details of this model may be improved by the introduction of small animals," it cannot be averred that the work is not perfectly adapted for its original use as a corbel, and to be seen at a considerable distance above the eye. In accordance with its situation the carver arranged an interval between the two masses of foliage, and, in order to get richness and lightness of appearance, as well as depth of shadow, he cut away that interval boldly, leaving only the stems of the upper mass of foliage marked between the two ranges or crowns of leafage. Considered in its proper aspect nothing can excel this work in spirit or beauty of composition. The treatment of detail is admirable. The human head—which has been introduced with thoughtful appreciation of its position in a building, in which place probably the whole was carved—is an excellent grotesque, and the intelligence displayed in its production is infinitely superior to that which contented itself with the inane lion's head of the last example. Time, neglect, and the white-wash brush have done their worst upon the original; the mould from which the copy in the Architectural Museum was taken was doubtless a mere "squeeze." We have, in the cast before us, a mere translation, yet the work will arrest the attention of all students, and modellers may be able to restore the damaged surface in their reproductions, but they must think deeply ere they will be able to introduce new elements into the design which will not do more harm than good. If such new elements are introduced with beneficial effect the work will be fitted for other uses than that of the original. "Design" will be called into play here by competitors who attempt to improve the model; probably on this account the committee makes its reference to such "improvements" permissive only, and not conditional.

This subject will be resumed in a future number.

Fine Arts.

FINE ART IN PARIS.—The exhibition, now annual, of the works of living artists, which is to open on the first

of May, is attracting unusual attention, although only half the usual time has elapsed since the last *salon*. The cause of this is in the changes that have been made in the constitution and direction of the Imperial Schools of Art, and with respect to the prizes for the exhibition itself. This year, for the first time, the greater portion of the jurors, three-fourths of the whole, are named by the body of artists who have received medals or decorations. The election took place some days since at the Louvre, when the following were selected:—Messieurs Cabanel, of the Institut, Professor of the Imperial School of Fine Arts; Robert Fleury, also member of the Institut and Director of the Imperial School; Gérôme and Pils, Professors of the School; Bida, François, Fromentin, Corot, and Meissonier, of the Institut; with H. Flandrin, Gleyre, and Leon Cogniet, the first and last members of the Institut, as supplementary members. The list of names selected by the artists exhibits a good understanding between them and the Imperial establishment on the one hand, and the Institut on the other, and sets at rest all fear relative to popular election of the juries. The members elected in the section of sculpture are, all but one, members of the Institut or of the Imperial Schools; and the selection in the case of the other juries is equally remarkable. Since the election referred to took place, the Administration has nominated the remaining quarter, the list being as follows:—In painting—Duc De Morny, M. Théophile Gautier, and M. Reiset, one of the Conservators of the Louvre. In sculpture and medal engraving—M. de Longprier, of the Institut and a Conservator, and M. Paul de Saint Victor, a literary man. In engraving—M. Henri Delaborde, Conservator; and in architecture—M. du Sommerard, the Director of the Musée de Cluny. A jury thus selected ought to give satisfaction, and to prevent the necessity for a painful exhibition of the rejected works like that which took place last year. At any rate the working of the new system will be watched with great interest as an important experiment, not only by Frenchmen but by foreigners. Juries are irresponsible tribunals entrusted with serious duties, and it certainly cannot be said that the world has yet arrived at any very satisfactory opinion respecting either the method of their election or the principles of their action. Almost at the moment of the election of the juries in question, one of those named, and one of the best artists of France of the present day, M. Hippolyte Flandrin, expired suddenly at Rome. M. Flandrin's minor works are well known abroad as well as at home, and amongst these, the most prominent, perhaps, are the portrait of a "Girl with a Poppy," and that of Prince Napoleon; but his highest claim as an artist rests on his religious works, including, amongst many others, the mural paintings in the churches of Saint-Vincent-de-Paul and Saint-Germain-des Prés. The latter include no less than twenty principal subjects and forty separate figures; and, unfortunately, the work is left unfinished. M. Flandrin was a pupil of M. Ingres, but he had entirely quitted the path of his master in the matter of colour. "The camp of colour and the camp of form," said Théophile Gautier the other day, "have each lost a chief." The Government has given M. Benedict Masson a commission to decorate the walls of the cloisters which surround the Court of Honour of the Hôtel of the Invalides. The four walls measure each about 150 feet long by 16 feet high. M. Masson has selected for subjects—the ages of Charlemagne, Saint-Louis, Louis XIV., and Napoleon. The vaultings of the ceiling are also to be decorated. The walls have been scraped and primed, and are now ready for the artist. The Chemin de Fer du Midi has performed a graceful act towards art by reducing the charge for carrying pictures and other works for the exhibition, to be held at Toulouse in the month of May, to one half the usual prices. The Imperial museums have received a large number of presents of late, some of great value; amongst the most recent are a bust in marble of the Countess de

la Forté, a very charming work, attributed either to Germain Pilon or Jean Gougeon; and a bas-relief representing the Virgin and Child, by Mino de Fiesolle, who died in 1486. There has been a very remarkable work of gold lately exhibited at the entrance of the choir of the Cathedral of Notre Dame. It is a new reliquary, manufactured at the expense of the chapter, after a design prepared by M. Viollet Le Duc, and contains an immense number of diamonds and other precious stones, the result of pious offerings. St. Louis is represented sitting on a throne, wearing a crown of rubies and emeralds, and holding the crown of thorns in his hand. St. Helena, with the Holy Cross, and Baudouin II., Emperor of Constantinople, are likewise seated on thrones. There is a platform over the head of these three personages, resting on the top of the thrones, of which the disc is surrounded by a river of diamonds. Turquoises are scattered over the surface, and in the centre is a pillar formed of enormous emeralds, which bears a crystal lantern, round which are the Twelve Apostles. The reliquary, which is silver gilt, cost £2,200. The diamonds and precious stones are estimated at £8,000.

FEMALE ART STUDENTS.—A memorial, bearing the signatures of twenty-three female students connected with the South Kensington and other art schools, who purpose to become professional artists, has been presented to the members of the Royal Academy of Arts. The memorialists state that it has long been the custom of the Royal Academy to admit into their school new students to supply vacancies, and that the students have been usually selected by means of an examination of works executed for the purpose; that for some years past, and up to the year 1863, it was permitted to female students to compete at these examinations, but that in June, 1863, two female students of the South Kensington School of Art sent in to the Royal Academy drawings executed by them for the purpose of competition, when, by a resolution of the Council, it was determined that their works should not be submitted to competition, and that no more female students should be admitted into the schools. The memorialists complain of that resolution, urging that the current of opinion and feeling of late years, on the part of the educated public, has been strongly in favour of the introduction of women to such callings and pursuits as are suitable to their sex, capacities, and tastes, and that one channel which has in modern times been opened for the enterprise of women in the pursuit of the arts of sculpture and painting, and that many women have availed themselves of that opening, and are at present earning their livelihood as artists; and that many other young women are preparing themselves by study and practice to follow their example. The memorialists, therefore, urge that with the view of their becoming really good artists, they ought to receive the best art education compatible with the circumstances, and that this is only to be had in the schools of the Royal Academy, which are the only free art schools in this country. The only reason alleged by the Academy authorities for excluding them was that the accommodation for students was limited. The memorialists, however, urge that they do not ask that any favour be extended towards the female competitors at the entrance examination, so that the entire number of students will not be increased. They merely desire "a fair field and no favour." In conclusion, they "pray that liberty may be restored to female students to compete for admission into the schools of the Royal Academy, upon the same terms and conditions as male students."

Manufactures.

NEW BAROMETER.—This barometer consists of a column of mercury placed in a glass tube, hermetically sealed at the top, and perfectly open at the bottom. The lower

half of the tube is of larger bore than the upper. If a column of mercury, of exactly the length which the atmosphere, at the given time, is capable of supporting, were placed in a tube of glass, hermetically sealed at the top, of equal bore from end to end, the mercury would be held in suspense; but immediately the pressure of the atmosphere increased, the mercury would rise towards the top of the tube, and remain there till, on the pressure decreasing, it would fall towards the bottom, and the portion which the atmosphere was unable to support would drop out. If, however, the lower half of the tube be made a little larger in the bore than the upper, then, when the column falls, the upper portion passes out of the smaller part of the tube into the larger, and, owing to the greater capacity of the latter, the lower end of the column of mercury does not sink to the same extent as the upper end, and the column, as a matter of course, becomes shorter. This falling will continue until the column is reduced to that length which the atmosphere is capable of supporting, and the scale attached thus registers this fall, or what is ordinarily termed the height of the barometer. From the above description it will be evident that, by merely varying the proportions in the sizes of the two parts of the tube, a scale of any length can be obtained. For example, if the tubes are very nearly the same size in bore, the column has to pass through a great distance before the necessary compensation takes place, and a very long scale may thus be obtained, say ten inches for every one inch rise and fall in the ordinary barometer. But if the lower tube is made much larger than the upper, the mercury passing into it quickly compensates, and a small scale, say from two to three inches for every inch, is obtained. To ascertain how many inches this rise and fall for an ordinary inch of the barometer would be, the inventor, Mr. Hicks, of Hatton-garden, attaches his barometer with a standard barometer to an air pump receiver, and thus ascertains the scale for every inch, from 31 to 27 inches. On the same principle, as regards the tube, the inventor has constructed an absolute standard barometer, graduating the scale from the centre, and reading it off at each end of the column with two verniers, to the one-thousandth of an inch. To ascertain the height of the barometer graduated in this way, he takes a reading of the upper surface of the column of mercury with one vernier, then of the lower surface in the same way with the other vernier, and by adding the two readings together, he gets the exact length of the column of mercury supported in the air, which is the true height of the barometer at the time. Gay-Lussac's pipette is introduced into the centre of the tube to prevent the possibility of any air passing up into the top. Such a barometer is convenient for measuring mountain heights, being very portable and getting rid of the cistern, and the corrections necessary when this is used.

NEW MAXIMUM THERMOMETER.—The novelty in this thermometer consists in the addition, near the bulb, of a small tube at right angles to the tube of the thermometer, and in connection with the bore; and when the thermometer is placed horizontally, this tube stands perpendicularly above it. On an increase of temperature taking place, the mercury will rise in the small bore, as in an ordinary thermometer; but on the temperature decreasing, instead of receding, in the small bore, as in an ordinary thermometer, the mercury in the bulb, on contracting, draws with it the mercury from the small side tube, and the then column of mercury in the small bore registers the maximum temperature. To reset the thermometer for future observation, lower the end near the bulb, and allow the mercury to fall until it fills the small tube at the side, then the thermometer shows the temperature at the time, and is set for a future observation.

MONSTER STEAM HAMMER.—Messrs R. and W. Morrison, of Newcastle-on-Tyne, have just forged what is believed to be the largest and most powerful steam hammer in the world, for the Russian Government. The piston rod, to which the hammer is attached, weighed no

less than 42 tons in its rough forged state, and now, when dressed down to the required dimensions, it has only been reduced to 35 tons. The length of the piston rod is 38ft., the diameter 2ft. 4 in., having a stroke of 14ft. 6 in., the piston being 6ft. 8 in. The forging of this mass of metal occupied 44 days. The cylinder for this hammer was cast at the Elswick Engine Works. Its diameter inside is 6ft. 8 in., its weight upwards of 40 tons. The two standards weigh nearly 40 tons each.

INDIAN CASHMERES.—Baron Charles Dupin has just published another section of his voluminous report on the Great Exhibition of 1851, being a continuation of that division of the work entitled, "The productive force of nations," and having reference to India, its population, society, and productions. "Of all the textile fabrics of India," says Baron Dupin, "the cashmeres made from the 'silky down' of the goats of Thibet have, at present, the greatest interest in European eyes." During the past half-century the influence of European commerce has worked a great change in these rich productions; an examination of those manufactured, say in 1800, will show how unpretending they were in comparison with the rich and sumptuous articles seen in London in 1851; the former were generally simple as regards decoration, with narrow borders and light embroidery. Baron Dupin says, that if he were engaged in the commerce of cashmeres, he would send out, not designs, but designers to India, and would say to them:—"Contemplate, study the brilliant nature to be found there; compare the marvellous effects of light on the plants of Asia, at break of day, at mid-day, in the evening even, when the sun has disappeared; acquire the taste, the genius of oriental artists, and then you may design cashmeres which will charm at once both east and west."

MUSEUM OF PATENTS, KENSINGTON.—It is highly desirable that this museum should be so constituted as to become an historical and educational institution for the instruction of skilled workmen. Amongst the various things necessary to be done in order to accomplish this object it is considered to be of importance that machines and exact models of machines, in subjects and series of subjects, showing the progressive steps of improvement in each branch of manufacture, should be exhibited. For example, taking the case of steamboats; in order to show the rise and progress of this invention, it is intended to exhibit in a series of exact models of machines, or by the machines themselves, each successive invention and improvement in steam propellers, from the first engine on the paddle system that drove a boat of two tons burthen (now in the museum) to the powerful machinery of the present day. Various interesting original machines and models of machines have lately been added to the museum. Amongst them may be mentioned a model of Trevethick's locomotive engine, the first that ran upon common roads, in 1803; an original stationary and pumping engine made on Newcomen's principle, to which Watt applied his important invention for condensing, by the means of a separate vessel and air pump, the steam that had been used and formerly condensed in the cylinder; the original fixed engine made by Watt in 1788, for converting rectilinear into circular motion; the very early original locomotive engine, brought from the Wylam Colliery in Northumberland, the first engine which moved by the contact of smooth wheels on smooth rails; the original "Rocket" locomotive engine, made by Stephenson and worked at the opening of the Liverpool and Manchester railroad in 1829; the original paddle wheel engine known as the "Comet engine," constructed and worked by Bell, on the Clyde, in 1811, the vessel worked by it being the practical commencement of steam navigation in Europe. Any patentee or other person desirous of assisting in furnishing complete series of models of machines, either by making a gift of a machine or model, or by the loan of a machine or model to be used as a pattern, is requested to communicate with the curator or the superintendent, at the museum. A collection

of portraits of inventors has been made, and placed in the Museum of Patents. All persons possessed of portraits or busts of inventors are invited to contribute to this collection, either by gift or loan. All expenses attending the removal, carriage, or repairs of any machine, model, or portrait contributed to the museum, will be paid out of the funds of the museum.

Commerce.

USE OF PETROLEUM FOR STEAMERS.—Further information has been received of the results of the inquiry of the commissioners appointed by the American government with regard to the use of petroleum for steamers, recently referred to in the *Journal*. The commission consisted of three persons, including the chief engineer of the United States Navy, and their investigations extended over five months, the process for adapting the oil for this purpose having been patented by Shaw and Linton, of Philadelphia. They were instructed to report "the relative evaporative powers of the oil as compared with anthracite coal, the practicability of its use, if unattended with danger, and to set forth its advantages, if any." As regards evaporation, the reply was that it is 103 per cent. superior in power to anthracite coal, while the time required for generating steam to 20lb. pressure was only 28 minutes against 60. The commissioners accordingly recommended the Secretary of the Navy to introduce the oil on board one of the Government steamers to determine practically its economical efficiency. The advocates for its introduction contend that in a vessel like the Cunard steamer *Persia* the saving, taking into account the smaller space required, and all other advantages, would amount to £2,400 each trip. Experiments on a large scale, it is added, will speedily be made in an ocean steamer by a company to whom the present patentees are about to transfer their rights. In addition to the discovery of extensive deposits of the oil in Southern Russia large quantities are alleged to have been found on the Pacific in California. The calculations as to economy, however, seem to have been based on the assumption that the price would remain as now after the increase of demand, and also upon the cost of coal in America, and not in England. Should the results, it is added, "equal what may be fairly anticipated, steam navigation will be revolutionised. A war steamer with oil fuel could hold the sea twice as long as now, and lines of commercial communication now too far apart, from the difficulty of carrying sufficient coal, would then be formed with ease. Direct lines from New York to Australia and between California and China would be of easy accomplishment."

ROYAL NATIONAL LIFE-BOAT INSTITUTION.—The annual general meeting of this Institution was held on Tuesday, the 15th ult., at the London Tavern, Sir J. S. Pakington, Bart., M.P., in the chair. The meeting was influentially and numerously attended. Mr. Richard Lewis, Barrister-at-Law, Secretary, read the annual report, which stated that on this, the fortieth anniversary of the Institution, the committee had once more to place on record the success which had rested on their labours, and to express their gratitude to a liberal public for its continued generous support. Perhaps the most striking feature in the history of the Institution during the past year was the large number of noble gifts, in the shape of the entire cost of twelve new life-boats, which had been presented to it by philanthropic individuals. The committee had the gratification to know that the Lords of the Admiralty were taking steps to provide every ship-of-war with an efficient life-boat, their lordships having paid the Institution the compliment to consult it on that important subject. The Committee propose to build and place at some of the principal fishing stations model or standard insubmersible fishing-boats, from which, after sufficient trial, others might be built in the

several localities; and thus a permanent improvement be established, which might lead to the saving of many lives on occasions of such boats being overtaken by gales of wind when at long distances from land. During the past year the institution has been enabled to send no less than 15 new life-boats to the coast, and numerous others were in course of construction. The life-boats of the institution numbered 132; and some of them were the means of saving no less than four hundred and seventeen lives and seventeen vessels during the past year, nearly the whole of them under dangerous circumstances, amidst high surfs, when no other description of boats could have been launched with safety. For these services—and for saving 297 shipwrecked persons by fishing and shore boats or other means—the Institution had granted rewards amounting to £1,351. On occasions of service, and on those of quarterly exercise of the life-boats, about 6,000 persons were afloat in them, yet not a single life had been lost. Transporting carriages and boat-houses had been provided for most of the said new life-boats. The committee reported that the number of wrecks during the past year was very large. During the time, however, that these storms lasted, the life-boats were providentially the means of rescuing no less than 355 shipwrecked persons. 1,602 casualties took place last year on the shores and in the seas of the British Isles, accompanied with loss of 568 valuable lives. During the same period 4,565 persons were rescued by life-boats, the rocket-apparatus, shore-boats, and other means. The number of lives saved during the forty years from the establishment of the Institution in 1824, to the end of the year 1863, either by its life-boats, or by special exertions for which it had granted rewards, was 13,568. During the past year fifteen silver medals, twenty-six votes of thanks inscribed on parchment, and £1,297 in cash had been granted for saving the lives of 714 persons by life-boats, shore and fishing-boats, and other means, on the coast and outlying banks of the United Kingdom. Since the formation of the Institution, it had expended on life-boat establishments nearly £100,000, and had voted 82 gold and 738 silver medals for saving life, besides pecuniary awards, amounting together to £17,830. The Committee referred to the cordial co-operation of the local Branch Committees, the Board of Trade, the Coast Guard, and the Railway and Steam Packet Companies. The expenditure of the Institution in the year 1863, on its life-boat establishments, was £11,877 14s. 1d.; £1,351 6s. 4d. in rewards for services to shipwrecked crews; and £2,441 9s. 1d. for coxswains' salaries, and the quarterly practice of the boats' crews. Considering the magnitude of the operations of the Institution, embracing the whole of the coasts of the British Isles, a large permanent annual income was indispensable to enable it to maintain, in an effective state, its one hundred and thirty-two life-boats, and to increase their number, should circumstances render it desirable to do so. The report was unanimously adopted.

Colonies.

RAILWAYS IN NEW SOUTH WALES.—The plans and working sections are finished for a further length of fifteen miles on the Great Northern Railway, and tenders will shortly be called for the formation of the line. The estimates for the extension from Blackheath as far as Lithgow's Valley on the western line, are in a forward state, and they will probably be laid before Parliament this session. The Government were lately taxed in the Assembly with not having placed on the estimates for 1864 a further sum for the Great Western Railway Extension, as the completion of the forty miles contracted for will, at the engineer-in-chief's estimate of £10,000 per mile, considerably exceed the sum voted for the Western Extension—£250,000. It was, however, explained that there would be no use in

obtaining a further vote at present, as it would be several months before the contracts were finished, after which the lines would have to be ballasted and the permanent way laid. The works on the Western Extension are steadily advancing towards completion.

TASMANIAN AGRICULTURE.—As compared with January, 1863, the present season opens with better prospects for the farmers, and the new crop promises to be at least an average. This colony has hitherto been free from rust, which has all but destroyed the crops in New South Wales, and all the grain that can be spared from this will be required for that colony. Victoria will also be a large importer, as its own produce will not nearly supply its consumption, whilst New Zealand, having, in consequence of the war, produced but little, will require to import largely. Labour is not so abundant as is required for the harvest, and no desire has yet been shown to use the reaping machines, of which there are a few in the colony. These machines are now general in Adelaide and Victoria. Sheep-shearing is now all but finished, and with satisfactory results. Fat stock from Victoria continue to come over by every steamer. Some of the settlers are now directing their attention to the breeding of rams, for the purpose of supplying the northern stations of New South Wales and Queensland, where it is found that the climate deteriorates the quality of the stock. There is a general desire for an intercolonial show of sheep in Tasmania this spring.

TASMANIAN IMMIGRATION.—The want of female labour is now much felt throughout this colony, especially in the country districts. Male farm labour is also getting scarce, but the cry for it is not so great as that for female.

COAL IN NEW ZEALAND.—At this moment the consumption of coal in New Zealand is not less than 60,000 tons a year, costing the colony something like £150,000. A colonial journal says:—"There is no doubt that we can supply a better coal than any imported into New Zealand, and at 25 per cent. less cost, and this with a profit sufficiently large to the holders to compete with any ordinary investment. What is wanted is a company started on a sufficiently broad basis, and we are certain, it this can be done, all the necessary capital can be raised, if not in Nelson, in the other provinces."

DEMERARA.—During last year some progress has been made in the cultivation of cotton, and that shipped from here has realized a good price, giving a good return to the growers. Before another twelvemonths have passed the cultivation of the leading staple is likely to be extended over the length and breadth of the colony. For some time past expeditions have from time to time been undertaken by private individuals in search of gold, but at length a favourable locality has been found, and in the latter end of October, the "British Guiana Gold Company" was formed, the capital being fixed at 75,000 dols. in 1,500 shares of 50 dols. each, all of which were taken within the time specified.

Obituary.

LORD ASHBURTON.—The death of the Right Hon. William Bingham, Lord Ashburton, took place on Wednesday, the 23rd of March, at his country-seat, the Grange, near Alresford, Hants. His lordship had been seriously ailing for some time from pulmonary complaints, but he was suddenly cut off by an attack of heart disease, to which he had been subject from his youth. His lordship was born in the last year of the last century, and was consequently in the 65th year of his age. He was the son of the well-known Alexander Baring, the prince of English merchants, who for so many years took a conspicuous part in the House of Commons, and was eventually raised to the peerage by Sir Robert Peel, who afterwards employed him in the negotiation of the celebrated treaty which bears his name, for the adjustment of our north-eastern

boundary with the United States. The confidence which Sir Robert reposed in the father was also extended to the son, and though the deceased peer had been a member of the House of Commons from the year 1826, on coming into office on the overthrow of the Whigs in 1841, he gave the Hon. Mr. Baring the post of one of the Secretaries to the Board of Control, an office that is now represented by the Under-Secretaryship for India. He continued in this office till 1845, when he was advanced to the more lucrative if not the more important office—now abolished—of Paymaster of the Forces and Treasurer of the Navy. This post he did not hold long, however, for in the following year Sir Robert Peel introduced his bill for the repeal of the Corn Laws, a measure in which he was zealously followed by his subordinate, who went out with him at the close of that struggle. This may be said to have concluded Lord Ashburton's political career. He remained in the House of Commons for two years longer, when his father died, and he was summoned to the Upper House. When at the University he took high honours, and through life he had a warm appreciation of all that related to science and literature. The hereditary interest he took in commercial affairs was acknowledged in 1855 by the Emperor of the French, who decorated him with the rank of Commander of the Legion of Honour in commemoration of the services he had rendered to commerce. In 1860 he was elected President of the Geographical Society, a post which he resigned from ill-health sometime previous to his death. But while he occupied himself with these questions they did not divert him from a question which ever lay near his heart—the moral and social elevation of the working classes. In their cause he was a practical philanthropist, and he possessed one of the true qualities for success in that field; he had a high opinion of their capacities while he was not blind to their defects. At the dinner of the Royal Agricultural Society held at Windsor in 1851—the year of the Great Exhibition, when the Prince Consort graced the meeting with his presence—to Lord Ashburton was entrusted the toast of the agricultural labourer. On that occasion he spoke with an eloquence which surprised every one, and with a good sense which seems to be a hereditary quality of the Baring family. He lamented the limited spread of education among the rustic classes; the inability to read and write was by far too much the rule among them, but yet he would not allow that they should be called uneducated. It could not be said, he argued, that that was an uneducated man who by the trained use of his eye alone was able to drive a furrow in a line of mathematical precision from one end of a field to the other; or who, with a calculation that looked like intuition, could tell to a handful how much seed was required to be put into a given area of soil. These, he said, were qualities that were too apt to be overlooked in the rage for making reading and writing everything, and other accomplishments nothing. The same principle he developed more fully a few years afterwards, when, in order to counteract what he believed to be the injurious tendency of an exclusive devotion to mere school education, he offered a series of prizes to the scholars of our national schools for a knowledge of "common things," a step the nature of which has since been fully recognised by other educators, but of which he was the first to set the example. His lordship was twice married, but he has left only a daughter by his second wife, the daughter of the late Right Hon. James Stewart Mackenzie. He was elected a member of the Society of Arts in 1864, and was a Vice-President of the Society.

JAMES PILLANS, M.A., LL.D., &c., was born at Edinburgh in 1778, being the son of a printer there, and was educated at the High School and University of that city. He died at his house, Inverness-row, Edinburgh, the 27th March, aged eighty-six. Among his early associates and fellow-students were Henry Brougham, Francis Horner, Francis Jeffrey, and other names, which afterwards became celebrated. He also made the acquaintance of

Thomas Campbell, in London, about 1797. Mr. Pillans began active life as a tutor, first in a private family, and afterwards at Eton; and in January, 1810, he became, at the suggestion of Francis Horner, a candidate for the rectorship of the High School of Edinburgh, then vacant by the death of Dr. Adam. To this office, which he filled for ten years and a half, he was elected by the Town Council. In 1820 he was unanimously chosen Professor of Humanity (Latin) in the University of Edinburgh, and filled that chair for forty three years, having retired only last year in consequence of failing strength. He last appeared in public at the meetings of the Education Section of the Social Science Congress held in Edinburgh last autumn, though then unable to take any part in the business. Throughout his long and temperate life he had scarcely ever known a day's sickness, and he only succumbed at length to the advance of years. For about fifty years his name has been widely known as an earnest and enlightened instructor of youth, and he was, in his earlier years particularly, a strenuous advocate of the cause of popular education. His career was marked both in the High School and University by great success in the cultivation of ancient literature, and particularly Latin verse. He was the author of several works, both on elementary and classical education, on ancient geography and Roman literature. As a teacher it was his boast that he had lessened the frequency of corporeal punishment in the High School, and substituted the supremacy of honour, principle, and affection for the reign of terror and the prostration of fear. He enjoyed in no common degree the regard and gratitude of his pupils, the list of whom included hundreds of the best educated and most successful of his countrymen.

Publications Issued.

THE VINE AND ITS FRUIT, especially in relation to the production of wine; embracing an historical and descriptive account of the grape, its culture and treatment in all countries, ancient and modern. By James L. Denman. Crown 8vo. pp. 358, price 8s. 6d. cloth. (*Longmans.*) This work is divided into sections, the first portion being devoted to the history and early origin of the vine, its characteristics and general diffusion; the most suitable soils, and the usual mode of culture; its natural maladies and numerous enemies; its popularity and utility. Another section treats of the system and practice pursued by the ancients in the management of their vine grounds, their superlative wines and their curious treatment of them. This is followed by a minute account of the character and qualities of modern wines, illustrated by statistical facts and historical incidents. The vintages of all the principal wine countries are then separately discussed, a separate section being given to each class. The chapter on Portugal especially demands attention, as showing the artifices there resorted to for changing the natural character of its staple product, with the sophistications practised in supposed deference to English taste. The particulars connected with the Hungarian vine grounds show their almost unlimited powers of production; whilst the natural and historical facts given relative to the Grecian Archipelago will be new to most English readers. Other sections of the work furnish information respecting the more distant and tropical regions, and the work concludes with some practical remarks on the choice and pre-ervation of wine; hints for judicious selection and cellar management; chemical analysis of alcoholic liquors; the hygienic properties of wine, and its use in the modern practice of physic. A short appendix gives the results of the Government commission of inquiry recently instituted for ascertaining the natural strengths of wine in the principal wine-growing countries of Europe, together with tables of the average strengths of the miscellaneous wines

submitted at the International Exhibition of 1862, as afterwards determined by the analytical labours of Mr. J. B. Keene, to whom the task was intrusted by government authority.

Forthcoming Publications.

THE LIFE, TIMES, AND SCIENTIFIC LABOURS OF THE MARQUIS OF WORCESTER.—*Mr. Bernard Quaritch*, of Piccadilly, is about publishing a "Life of the Marquis of Worcester," with a reprint of his "Century of Inventions," and with a commentary thereon by Mr. Henry Dircks, Civil Engineer, whose antiquarian taste will find ample scope in illustrating both the memoir and the noble author's "Century." The work derives a further interest from its being the first attempt to arrange a complete biography of the illustrious inventor of the steam-engine in its primitive form.

Notes.

FIRE ESCAPE LADDERS.—The Town Council of Tyne-mouth have lately had a set of scaling-ladders presented to them by Mr. George Fawcus, ship builder, of North Shields, one of their number, who is the inventor, and who now gives up his patent right to the public. The peculiarity of the invention consists in having a steel spring to fasten the ladders together, acting like the spring of an umbrella or a sword-bayonet catch. There is also a small iron half-button to keep the springs back when disconnecting the ladders, or at other times when necessary. There are two ladders eleven feet long, and two six feet long, which all join, the heads of all the ladders fitting all the feet indiscriminately. The ladders are now fitted to the fire-engine at North Shields, to which they are attached by straps and tackles, readily disconnected when required.

SPREAD OF EDUCATION.—Boswell, in his life of Johnson, mentions a reply made by the latter to a gentleman who was maintaining that a general diffusion of knowledge among the people was a disadvantage, for it made the vulgar rise above their humble sphere. Dr. Johnson replied, "Sir, while knowledge is a distinction, those who are possessed of it will naturally rise above those who are not. Merely to read and write was a distinction at first, but we see when reading and writing have become general the common people keep their stations. And so, were higher attainments to become general, the effect would be the same."

AROMATIC TREES.—A very common tree in the Ilhas do Mata is the Breio branco, which secretes from the inner bark a white resin, resembling camphor in smell and appearance. The fruit is a small black berry, and the whole tree—fruit, leaf, and stem—has the aromatic fragrance. By loosening the bark and allowing the resin to flow freely a large quantity may be collected, and the author of "The Naturalist on the Amazons" found it of great service in preserving insect collections from the attacks of ants and mites. Another tree, much rarer than the Breio branco, namely, the Umiri (*humirium floribundum*), growing in the same localities, distils in a similar way an oil of a most *recherché* fragrance. The yield, however, is very small. The native women esteem it highly as a scent. To obtain a supply of the precious liquid, large strips of bark are loosened and pieces of cotton left in soak underneath.

WORKMEN'S STORES.—The eighteenth half-yearly report of "Price's Workmen's Stores Industrial Society, Limited," states that the result of their transactions has been very prosperous, the profits made since the last half-yearly report being £172 19s. 2d. This sum, less £19 5s. for interest, and £41 8s. 6d. for the 5 per cent. on the fixed stock account, leaves £112 5s. 8d. to be divided.

In dividing this amount the committee recommend:—That a dividend of one shilling in the pound sterling be declared on members' dealings who shall be free of arrears, and sixpence in the pound sterling on non-members' dealings, and if any surplus remain it be placed to the reduction of the fixed stock account. That the interest on the members' shares and dividend on their dealings, be paid on two fixed days, between the hours of six and nine in the evening. The committee mention that nearly all the members of this Society have received more money from than they have paid to the funds of the Society, besides which their shares have considerably increased, £1 having advanced to £5 19s 6d. The amount received for goods sold during the last half-year was £3,112. The committee think that the statement of the above facts should recommend the society as a safe and profitable means of investing savings, as well as of obtaining genuine articles at the cheapest rate.

Correspondence.

THE FOLDING BOAT.—SIR,—Much has been said of late about this supposed new invention, notwithstanding that folding boats have been exhibited and experimented upon for at least the last forty years, while, by the description, this last proposal seems to be particularly crude and imperfect. It is flat-bottomed, and therefore quite unfit to live in a raging sea, and requires an enormous ballast, and it is rather surprising that the reported experiment should have been made in the face of the fact that the Rev. Mr. Berthron has for years past constructed and exhibited folding boats up to one hundred tons burden, and capable of carrying heavy ordnance. His mode of construction admits of the adoption of the finest form of body for sailing qualities. They are indestructible on rocks, can neither be sunk nor upset, require no ballast, and are, in fact, perfect life-boats. They can be lowered in their collapsed state, as they immediately expand on touching the water, and inflate the air compartments at the same time, so that the men can instantly jump into them and get off, for the oars and traps are always in them. The same gentleman has also constructed a very simple perpetual log, which has the further merit of always indicating the exact lee-way; also, a perpetual sounding lead, by means of which an accurate section of the bottom may be readily obtained. The Rev. Mr. Berthron has, of course, patented his inventions, and expended between two and three thousand pounds without the slightest prospect of any return. His first application was to the gentlemen who form the Board of Admiralty, when he was informed that the Lords considered his invention to be of a most perfect and beautiful description, but declined adopting it, as men-of-war were never permitted to take on board anything in the shape of a life-boat, because all the men would desert. They recommended him, however, to lay his invention before the commercial marine, but the reply he obtained from charterers and shipowners was, that the commercial conscience did not permit the slightest extra outlay for the mere purpose of saving human life, excepting so far as they were under the regulations of Parliament, but that if he could procure an Act to be passed they would, of course, submit, and adopt his folding boats, which they so much admired.

—I am, &c., HENRY W. REVELEY.

Reading.

PARLIAMENTARY REPORTS.

SESSIONAL PRINTED PAPERS.

Par.
Numb.

Delivered on 1st of March, 1864.

3. Bed of the Sea, &c.—Return.
10. Registers of Voters—Returns.

19. Railway and Canal, &c. Bills (121. Oswestry and Newtown and other Companies (Arrangements); 122. Pembroke and Tenby Railway; 123. Petersborough, Wisbeach, and Sutton Railway; 124. Portpatrick Railway; 125. Redruth and Falmouth Junction Railway; 126. Reigate and London (West End Junction Railway; 127. Rhymney Railway (Extensions); 128. Riddlesdale Railway; Rickmansworth, Amersham, and Chesham Railway; 129. Royston and Hitchin Railway; 130. Salisbury and Yeovil Railway; Salisbury Railway and Market House Company; 131. Scottish Central Railway (Dundee and Newtyle Extension), (Stations, &c.); 132. Scottish North Eastern and Alyth Railways; Scottish North Eastern, and Perth, Almond Talley, and Methven Railways; 133. Scottish North Eastern and Scottish Central Railway; 134. Scottish North Eastern Railway; 135. Sevenoaks, Maidstone, and Tunbridge Railway; 136. Sheffield, Chesterfield, and Staffordshire Railway; 137. Shrewsbury and Welchpool Railway; 138. Somerset and Dorset Railway (Cheddar Valley and Yatton). (Extension to Shepton Mallet); 139. South Eastern Railway (Nos. 1, 2, 3, and 4); 140. South Wales Mineral Railway; 141. South Yorkshire Railway; South Yorkshire Railway and River Dun Company (Transfer, &c.); 142. Stonehouse and Nailsworth Railway; 143. Sunningdale and Cambridge Town Railway; 144. Surrey and Sussex Junction Railway; 145. Swansea Vale and Neath and Brecon Junction Railway; Swansea Vale Railway; 146. Tamar, Kit Hill, and Callington Railway; 147. Tendring Hundred Railway; Tewkesbury and Malvern Railway; 148. Tooting, Merton, and Wimbledon Extension Railway; 149. Tottenham and Hampstead Junction Railway (Alexandra Park Extensions); 150. Trent, Ancholme, and Grimsby Railway; Tunstall Railway; 151. Wallingford and Watlington Railway; 152. Watford and Edgware Junction Railway; 153. Wensum Valley Railway; 154. West Drayton and Staines Railway; 155. West Grinstead, Cuckfield, and Haywards Heath Junction Railway; 156. West Norfolk Junction Railway; Weston super Mare, Axbridge, Cheddar, and Wells Railway; 157. West Riding and Grimsby Railway; 158. West Shropshire Mineral Railway (Branches, &c.); (New Lines); 159. West Sussex Junction Railway; 160. West Yorkshire Railway; 161. Wilts and Gloucestershire Railway; 162. Witney Railway)—Board of Trade Reports.

Delivered on 3rd March, 1864.

19. Railway and Canal, &c. Bills (174. Aberbrothwick Harbour 175. Hubberton Docks; 176. Hull Docks; 177. Lancaster Canal Transfer; 178. Launceston, Bodmin, and Wadebridge Junction Railway; 179. Londonderry and Lough Swill Railway; 180. Newry and Armagh Railway; Newry and Armagh Railway Extension; 181. Newtown and Machynlleth and Aberystwith and Welsh Coast Railways; 182. Parsonstown and Portanna Bridge Railway; 183. Petersfield and Bishops Waltham Railway; 184. Pulborough Storrington, and Steyning Railway; 185. Severn Valley Railway; 186. Staines, Egham, and Woking Junction Railway; Stamford and Essendine Railway; 187. Torbay and Brixham Railway; 188. Wellington and Drayton Railway; 189. Wolverhampton and Bridgnorth Railway)—Board of Trade Reports.
80. Coal—Return.
87. Railway Schemes (Metropolis)—Report.
- Denmark and Germany (No. 4)—Correspondence respecting Holstein, Lauenburg, and Schleswig.

Delivered on 4th March, 1864.

12. Deaths—Return.
55. (1). Railway and Canal Bills—Second Report from General Committee.
77. Reigate Borough—Return.
92. Police (Ireland)—Return.
95. Army—Supplemental Estimate for 1863-4.

MEETINGS FOR THE ENSUING WEEK.

- MON. ...Entomological, 7.
Medical, 8.
British Architects, 8.
Royal Inst., 2. General Monthly Meeting.
- TUES. ...Civil Engineers, 8. Renewed Discussion upon Mr. Phipps's Paper, "On the Resistances to Bodies passing through Water."
Pathological, 8.
Photographic, 8.
Anthropological, 8.
Royal Inst., 3. Prof. Helmholtz, F.R.S., "On the Natural Law of the Conservation of Energy."
- WED. ...Society of Arts, 8. Mr. Thomas Purdie, "On the Principle of Imitation as applied to the Decorative Arts."
Pharmaceutical, 8.
- THUR. ...Society of Arts, 8. Cantor Lectures. Dr. F. Crace Calvert, "On Chemistry applied to the Arts—Gelatin, Glue, &c."
Royal, 8.
Antiquaries, 8.
Linnean, 8. Mr. Daniel Hanbury, "On the *Garcinia* yielding Gamboge in Siam."
Chemical, 8.
R. Society Club, 6.
Royal Inst., 3. Prof. Helmholtz, F.R.S., "On the Natural Law of Conservation of Energy."

FRI. Astronomical, 8.

Royal Inst., 8. Dr. John Percy, F.R.S., "On Iron."

SAT. R. Botanic, 3.

Royal Inst., 3. Prof. Frankland, "On the Metallic Elements."

Patents.

From Commissioners of Patents Journal, March 25th.

GRANTS OF PROVISIONAL PROTECTION.

- Baking oatcake—532—J. Wright.
Baryta and strontia, production of—580—W. E. Newton.
Boat-detaching apparatus—468—W. M. Van Wageningen.
Bottles, closing or stoppering—588—F. Spiers and C. Pond.
Bottles, jars, &c., apparatus for stoppering—594—N. Thompson.
Brick-moulding machine—473—A. Jullienne and J. E. de la Combe.
Casting metals—556—H. Cochrane.
Cloth—560—R. A. Brooman.
Collisions on railways, apparatus for preventing—569—J. Price and R. E. Donovan.
Corn-reaping machinery—564—J. Backhouse.
Drying grain—578—J. H. Johnson.
Dyeing textile fabrics—584—J. P. Worrall.
Excrementitious matter, drying—592—E. Bishop and W. Bailey.
Fire arms and cannon, breech-loading—469—B. Burton.
Garden rollers—529—G. H. Ellis.
Glass-polishing—538—E. Hall.
Gunpowder, manufacture of—292—H. E. Drayson.
Hydraulic power—586—G. Davies.
Lamps, paraffin, &c.—470—T. Rowatt, jun., and A. Lighbody.
Looms—548—F. Lepoutre.
Manure—595—J. L. Norton.
Metallic coating of metals—497—F. Weil.
Millinery trimmings, machinery for manufacturing—506—C. G. Hill.
Needles for sewing machines—596—W. E. Broderick and W. Rees.
Oil-cans and lamps—566—J. Revell.
Packing cases—402—J. A. Lloyd.
Paper manufacture—542—W. Ibotson.
Photography—503—J. W. Swan.
Puddling furnaces—315—W. Taylor, W. Molineux, and H. Harrison.
Rollers for spinning machinery—598—G. T. Bousfield.
Sack-holder—546—J. Spencer.
Ships, apparatus for propelling—550—M. Henry.
Signal apparatus for steam-boilers—574—J. Lawrence.
Sizing cotton and other threads—531—W. Wilkinson.
Sofa or transformable bed—576—E. Cowles.
Spring tension regulator—600—G. Haseltine.
Steam engines—590—W. Hutchinson.
Sugar, glucose—552—A. Manbre.
Sugar manufacture—519—W. Miller.
Sugar-refining—568—W. E. Newton.
Thread-winding apparatus—536—J. Crutchett.
Utilizing refuse tinned iron, &c.—534—W. Clark.
Vulcanising india-rubber—562—C. Humphrey.
Washing blues—582—F. Tolhausen.
Weaving—558—W. Milligan and B. Duty.
Wood-boring machine—487—T. C. Barraclough.

INVENTIONS WITH COMPLETE SPECIFICATION FILED.

- Circular sawing machines—709—A. B. Childs.
Yeast presses—701—J. B. Jude.

PATENTS SEALED.

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| 2376. T. Lowe. | 2393. J. J. Chidley. |
| 2383. J. Bailey, G. W. Blake, and W. H. Bailey. | 2398. G. Elliot. |
| 2386. F. G. Mulholland. | 2399. B. Browne. |
| 2387. S. Mendel. | 2408. G. Dickey. |
| 2391. J. Cooper. | 3189. J. Astbury. |

From Commissioners of Patents Journal, March 29th.

PATENTS ON WHICH THE STAMP DUTY OF £50 HAS BEEN PAID.

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| 718. T. S. Truss. | 780. G. M. Coppo. |
| 719. J. Victor and J. Polglase. | 741. P. R. Hodge. |
| 729. A. Halsey. | 749. W. Brookes. |
| 738. T. Cardwell and D. Campbell. | 769. J. G. Willans. |
| 759. T. Davison and R. Paterson. | 788. W. D. Napier. |
| 716. W. I. Cranston. | 1039. S. Fox. |
| 773. P. M. Parsons. | 1153. J. Willis. |
| 851. B. Knowles. | 778. W. Sorrell. |
| 753. J. Chatterton & W. Smith. | 817. W. Clark. |

PATENTS ON WHICH THE STAMP DUTY OF £100 HAS BEEN PAID.

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| 834. R. Sims. | 838. R. Cassels and T. Morton. |
| 827. W. H. Collins. | 863. W. Ross. |